UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

April 24, 1998

PC Code No. **059201**
DP Barcodes: D188325, D187058, D236030

MEMORANDUM

SUBJECT: Environmental Fate and Effects Division RED Chapter for **Phosmet**

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This memo summarizes the attached EFED Environmental Risk Assessment (science chapter) for the Phosmet Reregistration Eligibility Decision document. It includes recommendations for labeling and mitigation measures and identifies gaps and uncertainties resulting from outstanding data requirements. The data suggest that on certain crops where there is a high application rate and frequency of application, expected environmental concentrations can lead to acute and chronic risk to both terrestrial and aquatic species. **Please note that this risk assessment is based on updated label use information provided by the registrant that is not currently reflected in the product labels. The registrant has indicated that they intend to update the labels accordingly.**

The assessment identified the following major issues of concern:

Avian Risk

- While phosmet is only moderately to practically non toxic to birds on an acute basis, the application rates result in residues on food items capable of producing acute avian toxicity.

- Even though phosmet is not considered to be persistent ($t_{1/2}$=3 days), the application rates and frequency of applications result in residues which trigger chronic toxicity concerns that are about 4-5 times greater than the level of concern. This chronic concern appears to be prevalent through out all phosmet crop uses.

Mammalian Risk

- While phosmet appears to be moderately toxic to mammals on an acute basis, the application rates result in residues on food items capable of producing acute toxicity to herbivores and insectivores. However, those animals that feed mainly on seeds, granivores, appear to be at a lower risk.

- Even though phosmet is not considered to be persistent ($t_{1/2}$=3 days), the application rates and frequency of applications result in residues which trigger chronic toxicity concerns. The RQ values are on average 20 times greater than the levels of concern. This suggests that chronic reproductive effects to mammals, especially those found in orchards (apples, cherries, citrus, kiwi, peaches, pears, pecans, plums, and walnuts) is very likely.

Risk to Freshwater Fish

- Phosmet has very high acute toxicity to freshwater fish. The high application rates and frequency of applications result in toxic environmental concentrations, thus evoking the restricted use category for most crops.

- Although phosmet has a high potential to cause chronic effects in freshwater fish, the environmental concentrations resulting from the application to most crops did not appear to exceed levels that would cause such effects. However, in pears, environmental concentrations did trigger chronic concerns to freshwater fish.

Risk to Freshwater Invertebrates

- The acute toxicity of phosmet to freshwater invertebrates is very high. Estimated environmental concentrations suggest a high probability of acute poisoning in all crop scenarios.

- Treatment of several crops (apples, grapes, kiwi, peaches, pears, pecans, and sweet potatoes), results in environmental concentrations that trigger chronic concerns for freshwater invertebrates.

Risk to Estuarine and Marine Fish

- Compared to the risk to freshwater fish, acute and chronic toxicity concerns appear to be somewhat less for marine and estuarine species.

Risk to Estuarine and Marine Invertebrates

- Acute toxicity of phosmet to aquatic invertebrates is very high, with the possibility of acute poisoning resulting from the application to all crops considered in the risk assessment.

- Chronic concerns are triggered for all crops, with the exception of alfalfa and cherries.

Risk to Non-Target Insects

- Phosmet is very highly toxic to honey bees and displays extended residual toxicity. Incidence of toxicity to honey bees have been reported.

Data Gaps

Environmental Fate:

Aerobic soil metabolism (162-1) and Leaching-Adsorption/Desorption (163-1) studies on the toxic degradate phosmet oxon should be required. These data are needed to better understand its persistence and mobility in the environment.

Ecological Effects:

There are no outstanding data gaps.

Risk Reduction

In addition to the label language proposed below, EFED recommends considering the following risk reduction measures to reduce risk to nontarget organisms from exposure to phosmet. These measures are expected to reduce the overall risk, but not necessarily below the level of concern. It should be noted that qualitative and field evaluations of these reduction methods have not been completed. These recommendations may need to be upgraded in the future.

- Few reduction/mitigation options are available for lessening the potential chronic and acute risk of toxic exposure of phosmet to terrestrial organisms (birds, mammals, etc.). In order to reduce this high risk, the registrant should explore the possibility of reducing the label rates, number of applications, or increase the interval between applications.

- For orchard uses, application by airblast will tend to result in less off-target drift than aerial application, thus reducing the impact on aquatic species. To help direct spray onto areas to be treated, spray last three rows windward of surface water using nozzles on one side only, with spray directed away from surface water. Avoid spray going over tops of trees by adjusting or turning off top nozzles. Shut off nozzles on the side away from the grove when spraying the outside row. Shut off nozzles when turning at ends of rows and passing tree gaps in rows.

- Risk of exposure to sensitive aquatic areas can also be reduced by avoiding applications when wind direction is toward an aquatic habitat.

Recommended Label Language

EFED recommends that the following language be included on the appropriate labels.

Statement to minimize the potential for surface water contamination for all end-use products:

> *This chemical can contaminate surface water through aerial and ground spray applications. Under some conditions, it may also have a high potential for runoff into surface water after application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas overlaying extremely shallow ground water, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetated filter strips, and areas over-laying tile drainage systems that drain to surface water.*

Label statements for toxicity to nontarget organisms:

<u>Manufacturing Use Products</u>

> *This pesticide is toxic to fish and aquatic invertebrates. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries oceans or other waters unless in accordance with the requirements of a National Pollutant*

Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

End Use Products:

This pesticide is toxic to fish and aquatic invertebrates. Do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean high-water mark. Drift and runoff may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwater or rinsate.

This product is highly toxic to bees exposed directly to treatment of residues on crops. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. Protective information may be obtained from your cooperative Agricultural Extension Service.

Environmental Risk Branch IV (ERB IV) RED Team for Phosmet

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ENVIRONMENTAL RISK ASSESSMENT FOR PHOSMET

ENVIRONMENTAL RISK ASSESSMENT

USE CHARACTERIZATION

Phosmet is a broad-spectrum organophosphate insecticide/acaricide that is used for control of a variety of pests including the alfalfa weevil, boil weevil, codling moth, leafrollers, plum curculio, grape berrymoth, and the oriental fruit moth. Phosmet is applied to terrestrial food areas as a delayed dormant spray or foliar application with aerial and ground equipment. Over 95% of phosmet usage is for insect control on commercial tree and vine fruit. Approximately 80% of this usage is applied to apples throughout the northeastern and western states, while the remaining 15% is applied to pears, pecans, peaches, cherries, almonds, plums, prunes, and grapes. Other sites of phosmet use include alfalfa, cotton, corn, nursery and ornamental plants.

The following table gives phosmet use areas and crops treated.

Use Area	*Crops*
California Coast	grapes, pears, apples
California Central Valley	grapes, alfalfa, pears, apple stone fruit, nuts
California Desert	grapes, alfalfa
Georgia	pecans
Texas	pecans, cotton
Oklahoma	pecans, cotton
Louisiana	pecans, sweet potato
Mississippi	pecans
Northwest	pears, beans/peas, apples, cherries
New York	apples
New Jersey	apples, blueberries
Maine	blueberries
Illinois	apples
Indiana	apples, peaches
Michigan	apples
Ohio	apples, blueberries, cherries

In response to an Agency request for updated label use information, the registrant (Elizabeth Codrea, Regulatory Product Manager with Gowan Company) provided, in a series of correspondence to Sid Abel, EFED/OPP dated January 14, 19, 20, 21, 22, and 29, 1998 the following use information. This information is not currently reflected in the product labels, however, the registrant has indicated that they intend to update the labels accordingly.

Crop Specific Use Information for Phosmet

Crop	*App. Rate (lbs.ai/A))*	*App. No.*	*App. Interval (days)*	*App. Method*
Alfalfa	1	8	14	Aerial
Almonds	3.7	3	20 and 1 dormant	Air Blast
Apples, Eastern-high	4	5	7	Air Blast
Apples, Eastern-low	1.5	10	7	Air Blast
Apples, Western-high	4	5	7	Air Blast
Apples, Western-low	1.5	10	7	Air Blast
Berries	1	5	7	Ground Spray Boom
Cherries	1.75	4	7	Air Blast
Citrus	2	3	30	Air Blast
Cotton	1	5	3	Ground Spray Boom
Grapes	1.5	4	At specific Growth Points[1]	Air Blast
Kiwi	2	6	14 and 1 dormant	Air Blast
Peaches-high	3	4	7	Air Blast
Peaches-low	2	5	7	Air Blast
Pears	5	3	21	Air Blast
Pecans	2.25	5	18	Air Blast
Plums/Prunes	3	5	14	Air Blast
Potatoes	1	5	10	Aerial
Potatoes, Sweet	1	5	10	Aerial
Walnuts	6	5	18	Air Blast

[1]Based on historical data, the average frequency is 20 days.

EXPOSURE CHARACTERIZATION

Chemical Name:	N-(Mercaptomethyl) phthalimide-S-(O,O-dimethyl phosphorodithioate	
Common name:	Phosmet	
Trade name:	Imidan	
Physical state:	crystalline solid	
Color:	off-white	
Solubility:	water:	25 mg/L at 20^{o}C
	acetone:	650 g/L at 25^{o}C
	benzene:	600 g/L at 25^{o}C
	methanol:	50 g/L at 25^{o}C
	toluene:	300 g/L at 25^{o}C
	xylene:	250 g/L at 25^{o}C
Vapor Pressure:	4.5E-07 mm Hg	
Henry's Law Constant:	7.5E-09 Atm. m^3/mole (calculated)	
Log K_{ow}:	2.78-3.04	

Nomenclature for the major degradation products:

Phosmet = N-(Mercaptomethyl) phthalimide-S-(O,O-dimethyl phosphorodithioate
Phosmet Oxon = O,O-Dimethyl-S-phthalimido-methylphosphorothioate
PiMOH = N-Hydroxymethyl phthalimide
Pi = Phthalimide
PiMS(O)M = N-methylsulfinylmethyl phthalimide
PiMOM = N-Methoxymethyl phthalimide
$PiMSO_3H$ = N-Sulfomethyl Phthalimide
PaAMOH = N-Hydroxymethyl Phthalamic acid
PaA = Phthalamic acid
Pa = Phthalic acid
4-OH Pa = 4-Hydroxy phthalic acid

a. Environmental Fate Assessment

Phosmet is stable to soil photolysis and appears to be stable to aqueous photolysis. Phosmet is subject to rapid hydrolysis under alkaline and neutral conditions and to a much lesser degree under acidic conditions. Microbial-mediated degradation is a major route of dissipation. In soils where microbial activity is minimal, leaching may be a significant route of dissipation for the chemical. Phosmet degrades rapidly (half-life, $t_{1/2}$=3 days) under aerobic conditions in soil (pH 7.4), and more slowly under anaerobic conditions ($t_{1/2}$=15 days, pH 7.1). Since phosmet hydrolyzes at neutral to alkaline pHs, these soil half-lives are reflective of both chemical hydrolysis as well as microbial degradation. Phosmet was not detected below the 10.5-inch soil layer in any of three field dissipation studies and dissipated to, or below, the level of detection (LOD) prior to the study's completion.

Phosmet oxon, the only known degradate of toxicological concern, was identified in a number of the environmental fate studies conducted. Phosmet oxon appears to be less mobile than phosmet as evidenced by its absence in leachates in the aged and unaged mobility study. In addition, phosmet oxon was limited to the upper soil layer in the field studies while phosmet was detected as low as the 10.5-inch soil layer. Phosmet oxon was not specifically identified in the soil leachate of the aged mobility study. In the anaerobic soil metabolism study, phosmet oxon was identified in very small amounts relative to the parent and other degradates. The pattern of formation and decline of phosmet oxon was not characterized well enough to formulate a full fate assessment.

A number of other degradates were identified in the aerobic soil metabolism and hydrolysis studies; these are listed in the preceding section. These degradates are various conjugates of the phthalimide, phthalamic acid, and phthalic acid moieties of the parent. All degradates appear to have greater mobility in soils, especially the anionic forms, under environmental conditions. No pattern of decline for the degradates was reported in the aerobic or anaerobic soil metabolism studies, therefore, persistence relative to the parent is unclear. The degradate N-methoxymethylphthalimide (maximum concentration 0.076 ppm immediately after 3rd app.) and phosmet oxon (maximum concentration 0.06 ppm on day 14 after final application) were identified in the field dissipation studies exclusively within the 0- to 3.5-inch soil layer. Phthalimide was not identified in the two studies for which it was monitored.

Based on the laboratory and field studies conducted, phosmet and phosmet oxon would appear to pose a threat to groundwater resources underlaying vulnerable soils. However, the relatively short half-life should reduce migration in most microbially active soils. Phosmet and possibly phosmet oxon, may contaminate surface waters in the dissolved phase mainly as a result of runoff-producing storm events shortly after field applications.

i. Degradation and Metabolism

Chemical Degradation

Phosmet is a soluble molecule (25 ppm in water at 20^{o}C), its octanol/water partition coefficient (K_{ow}) ranges from 602-1096, and its vapor pressure is 4.5x10^{-07} mm Hg. Phosmet is not expected to partition to air from soil or water environments.

Phosmet hydrolyzes in aqueous buffered solutions at pH's 5, 7, and 9 in the dark with half-lives of 179 hours, 9.4 hours, and 5.5 minutes, respectively. Hydrolysis under neutral or alkaline conditions will be a major dissipation pathway for phosmet. The major hydrolysis products identified (approximately 95 percent of applied radioactivity) were phosmet oxon, phthalamic acid, phthalic acid, and phthalimide.

Under acidic conditions (pH ~5) in an aqueous photolysis study, phosmet concentrations declined with a calculated half-life of 2.4 days using an artificial light source and 9.7 days in the dark controls. A soil photolysis study indicated that phosmet was stable under natural sunlight during a 30-day test period. Considering the rate of hydrolysis, lack of significant difference from the dark controls, and the absence of photodegradation in the soil study, photolysis appears to play only a minor role in the degradation pathway of phosmet under the test conditions in soils and water.

The major degradates from the photodegradation in water study, phosmet oxon, phthalimide, N-hydroxymethyl phthalimide, N-hydroxymethyl phthalamic acid, phthalamic acid, and phthalic acid closely tracked with the results of the hydrolysis study where there were common reference standards. The rates of formation were somewhat different for several of the degradates.

Microbial Degradation

Aerobic soil metabolism plays an important role in the degradation of phosmet. Next to hydrolysis at neutral or alkaline conditions, aerobic degradation appears to be the most important pathway. In a moist loam soil at pH 7.4, phosmet degraded with a calculated half-life of approximately 3 days (rate constants; 0.077 day^{-1} or 0.0032 hr^{-1}). After 150 days, approximately 1% of applied radioactivity remained as phosmet. Several major degradates comprising a combined maximum 12% of total radioactivity applied at day seven were observed. These included phthalimide (2.4%), phthalic acid (1.8%), phthalamic acid (0.5%), N-hydroxymethyl phthalamic acid (1.7%), and unknowns (<6%). All degradates declined to less than 0.01 ppm by day 150. $^{14}CO_2$ comprised 80% of the applied radioactivity on day 308.

Under anaerobic conditions in a flooded loam soil, phosmet degraded with a calculated half-life of 15 days (rate constants; 0.015 day^{-1} or 0.00064 hr^{-1}). The major degradate was identified in a supplemental study approved in 1990 as n-methoxymethyl phthalimide (5.68%). Other degradates, including phosmet oxon (0.3%) were identified at much lesser quantities. Degradates of phosmet in both the aerobic and anaerobic soils were qualitatively the same but differed in amounts formed.

ii. Mobility

Phosmet and several of its major degradates were moderately mobile to mobile in four different soil textural classes. While the parent compound is degraded quickly under neutral to alkaline conditions or by aerobic soil metabolism, several degradates; phthalimide, and N-hydroxymethyl phthalimide, may leach substantially (as evidenced by their presence in soil leachate), prior to significant aerobic metabolism. Several other metabolites were somewhat mobile and were detected only in the soil extracts: phosmet oxon, N-methoxymethyl phthalimide, and N-(methanesulfinyl)methyl phthalimide. These degradates, however, were not found to be persistent in the soil metabolism study.

In a Batch Equilibrium study, phosmet was observed to be moderately mobile to mobile in the four soils tested. Freundlich adsorption constants ranged from 1.17 to 15.8 (lowest non-sand Kd = 13.6). The Freundlich constants for the soils generally increased with increasing soil organic content, but the correlation did not appear to be strong. Soil organic carbon partition coefficients (K_{oc}), ranged from 716 to 10,400.

There were no Batch Equilibrium studies specific to the degradates. Therefore, adsorption and desorption potential of the degradates is largely unknown at this time.

iii. Field Dissipation

The registrant submitted three Terrestrial Field Dissipation studies conducted in Orange Cove and Visalia, California and Leland, Mississippi. Two of the three locations were representative of major growing regions for food crops and cotton, while the third was representative of ornamental crops grown only in drier regions of the U.S. At each of the locations, three plots were treated with Imidan 50-WP or Imidan 1E at the maximum specified rate for the specific crop. The dissipation half-lives observed for phosmet in the field were within the same order of magnitude (no more than 6X) as the half-life observed in the aerobic soil metabolism study. Results can be summarized as follows:

Aerobic soil metabolism	$t_{1/2}$ = ~3 days	pH 7.4
Orange Grove, California	$t_{1/2}$ = 18.6 days	pH 7.9
Visalia, California	$t_{1/2}$ = 5 days	pH 8.0
Leland, Mississippi	$t_{1/2}$ = 8 days	pH 6.2-7.0

Though the hydrolysis of phosmet is pH dependent, it appears that degradation rates in the field cannot be predicted solely by soil pH. Clearly, other routes of dissipation are also contributing to the disappearance of phosmet.

Detections of phosmet were largely in the upper 7 inches of soil at all three sites. Some minor detections were reported in lower depths, but none below 10.5 inches.

Degradates observed during the three studies were limited to minor detections of phosmet oxon (0- to 3-inch soil layer) and N-methoxymethylphthalimide (0- to 3.5-inch soil layer). No other degradates were reported. Neither of these degradates were identified in the lower soil layers of their respective studies, indicating low mobility or rapid degradation abiotically or by aerobic metabolism under environmental conditions. Both degradates identified in the field studies were found in the soil extracts and/or leachates in the column leaching study.

iv. Accumulation

The octanol/water partition coefficient for phosmet ranges from 602-1096. This value predicts that there is little to no potential for bioaccumulation. However, the short half-life of phosmet in neutral to alkaline environments and the relatively short aerobic metabolism half-life should act to mitigate the potential for significant accumulation in aquatic organisms. There were no studies submitted for review that confirm these statements, therefore, the likelihood of bioaccumulation remains somewhat uncertain as does the potential for depuration.

v. Spray Drift

The labels indicate that phosmet may be applied by ground spray boom equipment or aerially for certain crops. No phosmet-specific ground spray drift studies were reviewed. The Spray Drift Task Force (SDTF), a consortium of pesticide registrants, has submitted to the Agency a series of studies which are intended to characterize spray drift potential due to various factors, including application methods, application equipment, meteorological conditions, crop geometry, and droplet characteristics. EPA is evaluating these studies, which include ground spray as well as aerial application methods. In the interim for this assessment, EPA is relying on previously submitted spray drift data and the open literature to estimate off-target drift rates. The amount of drift from ground spray is estimated at 1% of the applied spray volume at 100 feet downwind. After its review of the studies, the Agency will determine whether a reassessment of the potential risks from the application of phosmet to nontarget organisms is warranted.

b. Terrestrial Exposure Assessment

Nongranular applications: The terrestrial exposure assessment is based on Hoerger and Kenaga (1972), as modified by Fletcher et al (1994)[1]. Terrestrial estimated environmental concentrations (EECs) for nongranular

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[1] Hoerger, F., and E.E. Kenaga. 1972. Pesticide residues on plants: Correlation of representative data as a basis for estimation of their magnitude in the environment. In F. Coulston and F. Korte, eds., *Environmental Quality and Safety: Chemistry, Toxicology, and Technology,* Georg Thieme Publ, Stuttgart, West Germany, pp. 9-28.

Fletcher, J.S., J.E. Nellessen, and T.G. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residues on plants. Environ. Tox. Chem. 13:1383-1391.

formulations were derived from maximum application rates that incorporated dissipation rates for phosmet. Uncertainties arise from a lack of data on interception and dissipation from foliar surfaces.

EECs on Avian and Mammalian Food Items From Applications of 1 lb ai/A (from Hoerger & Kenaga, 1972, modified by Fletcher et al, 1994).

Food Items	*Max. EEC (ppm) 1 lb ai/A*	*Mean EEC (ppm) 1 lb ai/A*
Short grass	240	85
Tall grass	110	36
Broadleaf plants and small insects	135	45
Fruits, pods, seeds, and large insects	15	7

c. Water Resource Assessment

i. Ground Water Assessment

Based on the laboratory and field studies conducted, it does not appear that phosmet or phosmet oxon will pose a significant threat to ground water resources. The chemical has moderate mobility (K_{ads}=1.17-15.8); however, it is very susceptible to aerobic soil metabolism ($t_{1/2}$=3 days). Three terrestrial field dissipation studies suggest that the parent compound does not persist long enough to exhibit substantial leaching.

A small amount of ground water monitoring data has been collected and reported to the STORET system and the *Pesticide in Ground Water Database*[2] on the occurrence of phosmet between 1981 and 1990. These data are summarized in the following table and a discussion of the major programs follow.

[2]Pesticide in Ground Water Database: A Compilation of Monitoring Studies: 1971-1991 National Summary. Published in September 1992. USEPA 734-12-92-001.

California Department of Health Services, Drinking Water Program.

The largest known well water sampling program for phosmet occurred from 1984 to 1990[3]. Municipal drinking water wells were sampled in California's Central Valley, Russian River Basin, Lake Shasta Basin and Los Angles County; areas of known use except Los Angles County whose water is partially obtained from ground water sources near the edge of the Central Valley. More than 65 municipal drinking water wells were sampled at the well head, in advance of any treatment processes. Samples were collected once at each well and repeated at five wells the following year. Phosmet was not detected in any samples collected during the this period. Levels of detection varied from 0.1 ppb to 10 ppb with 79 percent of the samples below 1 ppb.

No information on the use patterns of phosmet were available at the well locations, although phosmet was known to be used in all counties sampled except Los Angles County. Information provided by the registrant confirmed current use in all but two (Shasta and Sutter) of the sampled counties.

[3]Electronic mail communication from: Dr. David Storm, Chief Monitoring and Evaluation Unit, California Department of Health to Sidney Abel, USEPA, Office of Pesticide Programs. January 23, 1998.

Phosmet Occurrences in Ground Water (STORET and PGWDB)

Location	*Sampling Dates*	*Well Type*	*Sample Numbers*	*Results*[1] *(ug/l)*
California, Clark County	8/3/81 to 11/13/81	Ambient	6	<1
Alabama, Mobile	12/07/87	Ambient	2	2800[2]
California, Merced County	8/24/84 to 4/25/85	Municipal	5	3 values <1 2 values <0.1
California, Merced County	8/19/87 to 8/27/87	Municipal	26	<1
California, Riverside County	10/8/84	Municipal	2	<1
California, Fresno County	1/29/85 to 4/14/85	Municipal	5	1 value <10 1 value <1 3 values <0.5
California, Tulare County	8/30/84 to 5/3/85	Municipal	5	1 value <10 1 value <5 1 value <1 2 values <0.1
California, Kings County	1/9/85	Municipal	1	<0.1
California, Sonoma County	8/19/87 to 8/27/87	Municipal	6	<1
Oregon, Unatilla County	4/11/90	Municipal	3	<0.03
	9/18/90	Municipal	2	1 value <0.14 1 value <0.19
	9/19/90	Municipal	3	1 value <0.13 1 value <0.14 1 value <0.19
California, Maine, Oregon, Rhode Island, and Virginia	1984-1987	Ambient (Pesticide in Ground Water Database)	307 wells	No values above of below the MCL were reported?

[1]For values reported as "<" the result is either off-scale low actual value not known but known to be less than this value or below the level of detection and the detection limit is the value reported.
[2] Reported value is reflective of poor analytical technique reflecting a high LOD.

U.S. Bureau of Reclamation

In 1990, the U.S. Bureau of Reclamation collected eight phosmet samples from the Hermiston Well Field in Umatilla County, Oregon. One set of samples, collected at well Number 5, included phosmet residue analysis from water collected at the well head and after chlorination. In all samples, phosmet residues were not detected. Umatilla County is located in the heart of the apple growing region of the Columbia Basin. Confirmation of phosmet use in the area of the

Hermiston well field could not be determined. The Registrant usage information did not indicate that phosmet was currently being applied to apples in this region.

ii. Surface Water Assessment

Phosmet can contaminate surface water via runoff if runoff-producing rain events occur within the first few days to weeks post application. Phosmet's water solubility (25 mg/l) and its partition coefficient (K_{ads}=1.17-15.8) suggest that it will enter surface water via dissolution in runoff and sorbed to suspended and eroding materials. It appears that the persistence of phosmet in surface water may be limited by its susceptibility to biodegradation (aerobic soil metabolism, $T_{1/2}$ = 3 days) especially in water with moderate to high microbial activity and by abiotic hydrolysis under neutral to alkaline conditions ($T_{1/2}$ = 5.5 minutes at pH 9 and 9.4 hours at pH 7). In waters with short hydrological residence times (streams and rivers), its persistence is limited by the flow out of the system more so than by either metabolism or hydrolysis. However, its persistence in waters with high residence times (lakes and reservoirs) will be greater and controlled more so by metabolism and hydrolysis.

Surface water monitoring data collected and reported to the STORET system on the occurrence of phosmet between 1978 and 1994 indicate its presence in surface water in association with known use areas. The table below provides a summary of that data.

Phosmet Occurrences in Surface Waters (STORET)

Location	*Sampling Dates*	*Source Water*	*Sample Number*	*Results*[1]
Washington, Yakima County	7/23/82	Sediment-dry weight	2	<1 ug/kg
Washington, Whatcom County	7/16/87 to 7/28/87	Sediment-dry weight	6	<1 ug/kg
Wisconsin, Milwaukee County	6/17/92 to 6/28/94	Whole-water Ambient Stream	24	<1 ug/l
Wisconsin, Dane County	7/13/92 to 7/8/93	Whole-water Ambient Stream	8	<1 ug/l
Wisconsin, Dane County	5/30/93 to 6/23/94	Municipal Non-ambient stormwater	17	<1 ug/l
Oregon, Umatilla County[2]	4/11/90 to 9/18/90	Canals, sediments	10	<32 to <390 ug/kg
Oregon, Umatilla County[2]	4/11/90 to 9/18/90	Canals, Water	2	<0.03 and <2 ug/l
California, Fresno County	11/18/69?	Ambient Stream	1	<0.005 ug/l

[1]For values reported as "<" the result is either off-scale low actual value not known but known to be less than this value or below the level of detection and the detection limit is reported.

[2]Samples reported for Umtilla County are in association will the well data collected and reported in Table 1. The sampling locations occurred at specified distances from a specific well head.

It is important to note that surface water monitoring data are extremely limited; several counties among three states, and therefore, cannot be used for a definitive exposure and risk assessment. Although the levels found suggest that phosmet does not exceed concentrations above the very low ug/l range, the reported incidences were not correlated with use patterns, were collected randomly throughout the year, and were of insufficient numbers to make definitive statements as to extent of contamination of surface waters. Information on the site characteristics within the monitored basins would be necessary to understand the relative vulnerability of the recipient surface waters.

iii. Drinking Water Assessment

The estimated concentrations for drinking water are for phosmet only. Phosmet oxon, which has been included in the tolerance expression, is not included in the modeling due to the absence of fate information. Considering the limited presence of phosmet oxon in the laboratory and field studies (soil extract of the mobility study and upper 0- 3-inch soil layer in the field dissipation studies), phosmet oxon should not add appreciably to the concentration of parent compound in ground or surface water in most use areas.

Ground Water Sources

A preliminary ground water assessment was made using the Screening Ground Water model SCI-GROW[4] to estimate the "maximum" groundwater concentrations from the application of a pesticide to crops. SCI-GROW is based on the fate properties of the pesticide, the annual application rate, and the existing body of data from small-scale ground water monitoring studies. The model assumes that the pesticide is applied at its maximum rate in areas where the groundwater is particularly vulnerable to contamination. In most cases, a considerable portion of any use area will have ground water that is less vulnerable to contamination than the areas used to derive the SCI-GROW estimates. As such, the estimated maximum concentration derived using SCI-GROW should be considered a high-end to bounding estimate of "acute" exposure. The concentration for parent phosmet estimated using SCI-GROW is approximately **0.4 ppb**. The results of this model should be compared to available monitoring data when determining the potential for human exposure.

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[4]Barrett, M. 1997. SCI-GROW; "A proposed method to determine screening concentration estimates for drinking water from ground water sources." Draft. USEPA/OPP/EFED, September 1997.

Surface Water Sources

Tier II surface water drinking water EECs were calculated using PRZM3.1 to simulate the agricultural field and EXAMS 2.97.5 for fate and transport in surface water. Spray drift was simulated using the assumption that 1 to 5% of the applied phosmet reached surface water at the time of application and that 75 to 95% deposited on the target site depending on the application method; ground spray or air-blast. The remaining 4% to 20% either remained airborne or deposited on the ground beyond the drainage basin of the pond.

Environmental fate parameters used to estimate phosmet EECs can be found in the *Exposure Characterization.* The scenarios chosen for phosmet and the application rates, numbers, and intervals are presented in the table below. Scenarios were chosen to represent sites that were expected to produce runoff at greater than 90% of the sites where the appropriate crop is grown. Model simulation were made with the maximum application rates. Tier II one-in-ten year (upper tenth percentile) EECs are presented for all time interval except the annual average. The annual average is reported as the upper 90% confidence bound on the overall mean concentration. The EECs have been calculated so that in any given year there is a 10% probability that the maximum average concentration of that duration in that year will equal or exceed the EEC at the site.

Crop Specific Inputs to PRZM/EXAMS for Phosmet

Crop	*App Rate (lbs)*	*App No*	*App. Interval (days)*	*App Method*	*Scenario Location*
Alfalfa	1	8	14	Aerial	Oregon
Almonds	3.7	3	20 and 1 dormant	Air Blast	California
Apples, Eastern-high	4	5	7	Air Blast	New York
Apples, Eastern-low	1.5	10	7	Air Blast	New York
Apples, Western-high	4	5	7	Air Blast	Oregon
Apples, Western-low	1.5	10	7	Air Blast	Oregon
Berries	1	5	7	Ground Spray Boom	Michigan
Cherries	1.75	4	7	Air Blast	Wisconsin
Citrus	2	3	30	Air Blast	Florida
Cotton	1	5	3	Ground Spray Boom	Mississippi
Grapes	1.5	4	At specific Growth Points[1]	Air Blast	New York
Kiwi	2	6	14 and 1 dormant	Air Blast	California
Peaches-high	3	4	7	Air Blast	Georgia
Peaches-low	2	5	7	Air Blast	Georgia
Pears	5	3	21	Air Blast	Oregon
Pecans	2.25	5	18	Air Blast	Georgia
Plums/Prunes	3	5	14	Air Blast	Oregon
Potatoes	1	5	10	Aerial	Maine
Potatoes, Sweet	1	5	10	Aerial	Louisiana
Walnuts	6	5	18	Air Blast	Oregon

[1] Based on historical data, the average frequency is 20 days.

PRZM/EXAMS Surface Water Concentrations for Phosmet (PPB). 1 in 10 Years Concentrations Except Mean.

Crop	*Scenario location*	*Peak*	*4-Day*	*21-Day*	*60-day*	*90-day*	*Overall Mean*	*90% CB Mean**
Alfalfa	Oregon	3.0	0.60	0.20	0.10	0.10	0.05	0.06
Almonds	California	10.3	1.30	0.50	0.20	0.10	0.07	0.08
Apples, Eastern-high	New York	26.7	5.00	1.40	0.80	0.50	0.20	0.20
Apples, Eastern-low	New York	15.6	2.10	0.60	0.30	0.30	0.08	0.09
Apples, Western-high	Oregon	11.2	1.50	0.80	0.50	0.30	0.10	0.10
Apples, Western-low	Oregon	0.4	0.10	0.03	0.03	0.02	0.01	0.01
Berries	Michigan	11.8	1.60	0.40	0.20	0.10	0.03	0.03
Cherries	Wisconsin	9.5	1.80	0.60	0.30	0.20	0.06	0.06
Citrus	Florida	12.9	1.90	0.60	0.30	0.20	0.06	0.06
Cotton	Miss.	29.9	4.40	1.00	0.40	0.20	0.06	0.09
Grapes	New York	18.7	4.20	1.00	0.60	0.40	0.10	0.20
Kiwi	California	137.3	17.10	3.90	2.50	1.70	1.00	1.00
Peaches-high	Georgia	16.2	2.70	1.00	0.50	0.30	0.10	0.10
Peaches-low	Georgia	8.9	1.70	0.50	0.20	0.20	0.05	0.05
Pears	Oregon	140.0	17.70	3.70	3.60	2.40	1.00	1.00
Pecans	Georgia	23.7	3.30	0.80	0.40	0.30	0.08	0.09
Plums	Oregon	8.4	1.00	0.40	0.40	0.20	0.10	0.10
Potatoes	Maine	7.9	1.20	0.50	0.20	0.20	0.05	0.05
Potatoes, sweet	Louisiana	20.6	3.50	1.00	0.40	0.30	0.08	0.09
Walnuts	Oregon	8.4	1.00	0.40	0.30	0.20	0.10	0.10

*Upper 90th percent confidence bound on the overall mean concentration. Value to be used in chronic risk assessments.

The upper 90% confidence bound on the overall means are the best value to use in cancer risk assessments as they are the best estimate of lifetime mean concentrations. The maximum 1 in 10 year concentrations are the suggested values to use in acute risk assessments.

iv. Use of Screening Estimates for Drinking Water Assessments

EFED recommends that the EECs generated from SCI-GROW (for groundwater sources) and from PRZM-EXAMS (for surface water sources) be used for the drinking water risk assessment for phosmet. The monitoring data reported here are not sufficiently reliable and of adequate quantity for use in drinking water assessments. All monitoring data that could be traced to its original owner could not be correlated with a specific use pattern or to drinking water intakes. Several studies were specifically targeted to drinking water sources and as such, can be used as evidence that under the conditions of use and site characteristics of the study unit, phosmet concentrations are less than those estimated by the models.

Model predictions provide a screen to eliminate those chemicals that are not likely to cause concerns in drinking water. Exceedances in drinking water risk assessments using the screening model estimates do not necessarily mean a risk actually exists but point to the need for better data (e.g., monitoring studies specific to use patterns and drinking water sources) on which to make a finding.

ECOLOGICAL EFFECTS HAZARD ASSESSMENT

The available data show that the toxicity potential after phosmet exposure is as follows:

* Avian acute - moderate to practically non-toxic (840 - >5000 ppm)
* Avian chronic - possible reproductive concern (NOEC = 60 ppm, LOEC = 150 ppm)
* Mammalian acute - moderate toxicity (113 mg/kg)
* Mammalian chronic - possible reproductive concern (LOEC = 20 ppm)
* Honey bee acute - very highly toxic (1.06 ug/bee)
* Fish (freshwater) acute - very high to moderate toxicity (0.07 - 11.0 ppm)
* Fish (freshwater) chronic - possible growth effects on fry (0.0044 ppm)
* Fish (marine/estuarine) acute - highly toxic (0.17 ppm)
* Invertebrates (freshwater) acute - very highly toxic (0.002 - 0.008 ppm)
* Invertebrates (freshwater) chronic - possible growth effects (0.0011 ppm)
* Invertebrates (marine/estuarine) acute - very highly toxic (0.016 - 0.170 ppm)
* Invertebrates (marine/estuarine) chronic - 1st and 2nd generation survival (0.0005 ppm)

* Incident Reports - Honey bee mortality in California and North Carolina

Notice that the toxicity testing does not test all species of birds or fish. Only two **surrogate species** for both birds and freshwater fish are used to represent all bird species (680+) and freshwater fish species (2000+) in the United States. For mammals, acute studies are usually limited to the Norway rat or the house mouse. Estuarine/marine studies include testing a crustacean, a mollusk, and a fish; however, reptiles and amphibians are not tested. The assessment makes the assumption that a chemical's toxicity to birds is similar to that in reptiles. The same assumption applies to amphibians and fish; the tadpole stage of amphibians is assumed to have the same sensitivity as a fish. Therefore, the results from toxicity tests on surrogate species are considered applicable to other member species within their class and are extrapolated to reptiles and amphibians.

a. Toxicity to Terrestrial Animals

i. Birds, Acute and Subacute

Avian Acute Oral Toxicity

Species	*% ai*	*LD50 (mg/kg)*	*Toxicity Category*	*MRID No. Author/Year*	*Study Classification*[1]
Mallard duck *(Anas platyrhynchos)*	95.4	2000	Practically nontoxic	00084460 Fink/76	Core

[1] Core study satisfies guideline requirements. Supplemental study is scientifically sound, but does not satisfy guidelines.

Since the LD50 is 2,000 mg/kg, phosmet is categorized as practically nontoxic to avian species on an acute oral basis. The guideline (71-1) is fulfilled (MRID 00084460).

Avian Subacute Dietary Toxicity

Species	*% ai*	*5-Day LC50 (ppm)*	*Toxicity Category*	*MRID No. Author/Year*	*Study Classification*
Ring-necked pheasant (*Phasianus calchicus*)	tech.	> 1620	Slightly Toxic	00022923 Hill (1975)	Core
Northern bobwhite quail *(Colinus virginianus)*	tech.	840	Moderate toxicity	0013707 Gough et al. (1967)	Supplemental
Northern bobwhite quail *(Colinus virginianus)*	tech.	501	Slight toxicity	00022923 Hill (1975)	Core
Mallard duck *(Anas platyrhynchos)*	tech.	> 5000	Practically non-toxic	00022923 Hill (1975)	Core
Mallard duck *(Anas platyrhynchos)*	30.2	3200	Slight toxicity	00109135 Beliles et al. (1965)	Supplemental

Since the LC50 ranged from 840 ppm to greater than 5,000 ppm, phosmet ranged in toxicity from being moderately toxic to practically nontoxic. Based on the most conservative estimate, phosmet is categorized as moderately toxic to avian species on a subacute dietary basis. The guideline (71-2) is fulfilled (MRID 00013707, 00022923, 00109135).

ii. Birds, Chronic

Avian Reproduction

Species	*% ai*	*NOEC/LOEC (ppm)*	*LOEC Endpoints*	*Mrid. No. Author/Year*	*Study Classification*
Northern bobwhite quail *(Colinus virginianus)*	97.4%	60/150	Number of eggs produced	00125786 Fletcher et al., (1982)	Core
Mallard duck *(Anas platyrhynchos)*	97.4%	60/150	Number of eggs produced	00105999 Fletcher et al., (1982)	Core

Phosmet exposure of 150 ppm resulted in chronic effects to avian reproduction. i.e., reduced number of eggs laid. The guideline (71-4) is fulfilled (MRID 00125786; 00105999).

iii. Mammals, Acute and Chronic

Mammalian Toxicity

Species	*% ai*	*Test Type*	*Toxicity Value*	*Affected Endpoints*	*MRID No.*
Laboratory rat *(Rattus norvegicus)*	97.4%	Acute oral	LD50 = 113 mg/kg	Morbidity	0046189
Laboratory rat (*Rattus norvogicus*)	95.0%	Chronic, reproductive	NOEC/LEL 20/80 ppm	Decreased fertility, number of live pups/litter, pup weight.	4150001

Phosmet is moderately toxic to small mammals on an acute oral basis (LD50= 113 mg/kg). However, with a lowest observable effect level (LEL) of 80 ppm, phosmet has the potential for chronic reproductive effects, i.e., decreases in fertility, number of live pups, number of live pups per liter, pup weight, lactation index and fertility index.

iv. Insects

A honey bee acute contact study using the TGAI is required for phosmet because its use on alfalfa, citrus, pome fruits, stone fruits, nuts, and corn will result in honey bee exposure. Results of this test are tabulated below.

Nontarget Insect Acute Contact Toxicity

Species	*% ai*	*LD50 (μg/bee)*	*Toxicity Category*	*MRID No. Author/Year*	*Study Classification*
Honey bee *(Apis mellifera)*	tech.	1.06	Highly toxic	00066220 Atkins et al. (1976)	Core
Honey bee *(Apis mellifera)*	50.0% WP	At 1 lb ai/A, 3 hr old residues caused 100% mortality	Highly toxic	05000837 Johansen (1972)	Core
Honey bee *(Apis mellifera)*	50.0% WP	Residues highly toxic thru 4 hrs	Highly toxic	00060625 Johansen and Hutt (1962)	Core

Phosmet is categorized as highly toxic to bees on an acute contact basis (LD50 = 1.06 ug/bee). The guideline (141-1) is fulfilled (MRID 00066220, 05000837, 00060625).

b. *Toxicity to Freshwater Aquatic Animals*

i. *Freshwater Fish, Acute*

Freshwater Fish Acute Toxicity

Species/ Flow-through or Static	*% ai*	*96-hour LC50 (ppm) (nominal)*	*Toxicity Category*	*MRID No. Author/Year*	*Study Classification*
Rainbow trout *(Oncorhynchus mykiss)*	97.0%	0.23	Highly toxic	00109135 Beliles et al., (1965)	Core
Rainbow trout *(Oncorhynchus mykiss)*	95.8%	0.56	Highly toxic	00063194 Julin (1977)	Core
Bluegill sunfish *(Lepomis macrochirus)*	95.8%	0.07	Very Highly toxic	00063194 Julin (1977)	Core
Bluegill sunfish *(Lepomis macrochirus)*	95.3%	0.12	Highly toxic	112306 sleight (1973)	Supplemental
Channel catfish (*Ictalurus punctatus*)	95.8%	11.0	Slightly toxic	00063194 Julin (1977)	Supplemental
Fathead Minnow (*Pimephales promelas*)	95.8%	7.3	Moderately toxic	00063194 Julin (1977)	Core

Since the LC50s ranged from 0.07 - 11.0 ppm, phosmet exposure to freshwater fish can result in very high to slight toxicity on an acute basis. It is noteworthy that rainbow trout and bluegill sunfish yielded roughly similar estimates of toxicity while channel catfish and flathead minnows were roughly an order of magnitude less sensitive. The guideline (72-1) is fulfilled (MRID 000109135, 00063194).

Freshwater Fish Acute Toxicity (TEP)

Species	*% ai*	*96-hr LC50 (ppm)*	*Toxicity Category*	*MRID No. Author/Year*	*Study Classification*
Rainbow trout (*Oncorhynchus mykiss*)	11.55%	1.56	Moderately toxic	00107136 McCann (1972)	Supplemental
Rainbow trout (*Oncorhynchus mykiss*)	50.0%	0.29	Highly toxic	00090364 McCann (1971)	Supplemental
Rainbow trout (*Oncorhynchus mykiss*)	50.0%	0.50	Highly toxic	00063194 Julin (1977)	Supplemental
Fathead minnow (*Pimephales promelas*)	50.0%	9.0	Moderately toxic	00063194 Julin (1977)	Supplemental
Fathead minnow (*Pimephales promelas*)	50.0%	7.5	Moderately toxic	00063194 Julin (1977)	Supplemental

Toxicity values were determined for the technical end product (TEP) with LC50 values (range: 0.29 - 9.0 ppm) similar to those using technical grade. Again, fathead minnows appeared to be roughly 10 times less sensitive to the effects of phosmet. Based on these data, phosmet is moderately to highly toxic to freshwater fish.

ii. Freshwater Fish, Chronic

Freshwater Fish Early Life-Stage Toxicity Under Flow-through Conditions

Species	*% ai*	*NOEC/LOEC (ppb)*	*MATC[1] (ppb)*	*Endpoints Affected*	*MRID No. Author/Year*	*Study Classification*
Rainbow trout *(Oncorhynchus mykiss)*	94.3%	3.2/6.1	4.4	Fry survival, growth	40938701 Cohle (1988)	Supplemental

[1] Defined as the geometric mean of the NOEC and LOEC.

Based on early life-stage toxicity tests, the maximum acceptable toxic concentration is 4.4 ppb. The primary toxic effects included reduced fish (fry) survival and growth. The guideline (72-4) is fulfilled (MRID 40938201).

iii. Freshwater Invertebrates, Acute

Freshwater Invertebrate Acute Toxicity

Species/Static or Flow-through	*% ai*	*48-hour EC50 (ppb) (nominal)*	*Toxicity Category*	*MRID No. Author/Year*	*Study Classification*
Waterflea (Daphnia magna)	95.8%	5.6	Very highly toxic	00063194 Julin (1977)	Core
Gammarus fasciatus	95.8%	2.0	Very highly toxic	00063193 Sanders (1972)	Core

Since the EC50 ranged from 2.0 - 5.6 ppb, phosmet is categorized as very highly toxic to aquatic invertebrates on an acute exposure basis. The guideline (72-2) is fulfilled (MRID 00063194, 00063193, 43752603, 43752603).

Acute Toxicity to Invertebrates (TEP)

Species	*% ai*	*48-hour EC50 (ppb)*	*Toxicity category*	*MRID No. Author/Year*	*Study Classification*
Waterflea (Daphnia magna)	51.0%	24.0	Very highly toxic	40612701 Burgess (1987)	Supplemental
Waterflea (Daphnia magna)	51.0%	8.64	Very highly toxic	43752603	Supplemental

Acute toxicity tests using TEP indicated that phosmet is very highly toxic to daphnids even though there was a near four-fold difference in EC50 estimates for TEP in daphnids (range 8.64 - 24 ppb). The lower-end estimate of 8.64 ppb is consistent with the toxicity estimates obtained using TGAI.

iv. Freshwater Invertebrate, Chronic

Freshwater Aquatic Invertebrate Life-Cycle Toxicity

Species/Static Renewal	*% ai*	*21-day NOEC/LOEC (ppb)*	*MATC[1] (ppb)*	*Endpoints Affected*	*MRID No. Author/Year*	*Study Classification*
Waterflea *(Daphnia magna)*	99.0%	0.75/1.1	1.1	Adult length Young/Adult	406528-01	Core

[1] defined as the geometric mean of the NOEC and LOEC.

Phosmet has the potential for chronic toxicity to daphnids and possibly other freshwater invertebrates. Exposure to as little as 1.1 ppb phosmet can result in growth effects to adults and young. The guideline (72-4) is fulfilled (MRID 40652801).

c. Toxicity to Estuarine and Marine Animals

i. Estuarine and Marine Fish, Acute

Estuarine/Marine Fish Acute Toxicity

Species/Static	*% ai*	*96-hour LC50 (ppm) (nominal)*	*Toxicity Category*	*MRID No. Author/Year*	*Study Classification*
Sheepshead minnow *(Cyprinodon variegatus)*	94.0%	0.17	Highly toxic	40612702 Bowman (1987)	Core

Acute toxicity tests on sheepshead minnows resulted in an LC50 of 0.17 ppm. Phosmet is categorized as highly toxic to estuarine/marine fish on an acute exposure basis. The guideline (72-3a) is fulfilled (MRID 40612702).

ii. Estuarine and Marine Fish, Chronic

At the time of this review, no data were available on estuarine/marine fish early life-stage toxicity tests using the TGAI. However, this study will not be required because the intended use sites for phosmet are not generally in the vicinity of marine environments and those that are (citrus) appear to have a low toxic exposure potential to fish. Since acute values for rainbow trout were calculated at 230 ppb (150 - 350 ppb) and the NOEC at 4.4 ppb, EFED extrapolated a chronic NOEC for marine/estuarine species based upon this freshwater fish chronic to acute ratio (230 : 4.4). The rational for this action is taken from the observation that the acute toxicity (170 ppb) for the marine/estuarine fish (sheepshead minnow) is within the acute toxicity 95% confidence interval range of the rainbow trout. Although this NOEC (3.5 ppb) is only an estimate, it will be used to calculate the chronic RQ values for marine/estuarine fish.

iii. Estuarine and Marine Invertebrates, Acute

Estuarine/Marine Invertebrate Acute Toxicity

Species/Static or Flow-through	*% ai.*	*96-hour LC50 (ppb)*	*Toxicity Category*	*MRID No. Author/Year*	*Study Classification*
Brown shrimp	95.0%	48hr LC50=2.5	Very highly toxic	40228401 Mayer (1986)	Supplemental
Fairy shrimp	95.3%	48hr LC50 = 170	Highly toxic	40094602 Mayer (1986)	Supplemental
Eastern oyster (*Crassostria virginica*)	95.0%	>1,000	Moderately toxic	40228401 Mayer (1986)	Supplemental
Mysid *(Americamysis bahia)*	94.3%	1.6	Very highly toxic	40657201 Burgess (1988)	Core

Acute toxicity tests on estuarine and marine invertebrates resulted in LC50 values ranging from 1.6 to greater than 1,000 ppb. Based on the more conservative estimates, phosmet is categorized as very to very highly toxic to estuarine/marine shrimp species on an acute exposure basis. Bivalves appeared to be more tolerant to phosmet with moderate toxicity values of greater than 1,000 ppb; their reduced sensitivity to phosmet may be a result of the duration of testing (10 days) and/or their avoiding acute exposure through remaining closed. The guideline (72-3b and 72-3c) is fulfilled (MRID 40657201, 40228401).

iv. Estuarine and Marine Invertebrate, Chronic

Estuarine/Marine Invertebrate Life-Cycle Toxicity

Species	*% ai*	*21-day NOEC/LOEC (ppb)*	*MATC[1] (ppb)*	*Endpoints Affected*	*MRID No. Author/Year*	*Study Classification*
Mysid *(Americamysis bahia)*	95.5%	0.37/0.69	0.51	Survival reduced for adults and second generation	42724901 Drotter (1993)	Core

[1] defined as the geometric mean of the NOEC and LOEC.

Phosmet has the potential for chronic toxicity concerns. Exposure of marine invertebrates to greater than 0.69 ppb resulted in a reduction in first- and second-generation survival. The guideline (72-4) is fulfilled (MRID 42724901).

d. Toxicity to Plants

i. Terrestrial

Currently, terrestrial plant testing is not required for pesticides other than herbicides and fungicides except on a case-by-case basis (e.g., labeling contains phytotoxicity warnings, incident data or literature that demonstrates phytotoxicity).

ii. Aquatic Plants

Currently, aquatic plant testing is not required for pesticides other than herbicides and fungicides except on a case-by-case basis (e.g., labeling bears phytotoxicity warnings, incident data or literature that demonstrates phytotoxicity).

e. Reported Incidence of Mortality to Non-target Species

Three incidents of non-target exposure have been reported in the EPA Ecological Incident Information System and Incident Data System database. The reported incidents include those in which phosmet is implicated as a highly probable cause of the mortality.

North Carolina Department of Agriculture investigated complaints that bee mortality was occurring as a result of pesticides applied to surrounding apple orchards. When bee tissue was analyzed, the only pesticide found was phosmet (0.12 ppm). Phosmet was also found on the apple leaves at a concentration of 180 ppm.

The American Beekeeping Federation noted a phosmet incident to honey bees in Los Banos, CA, after bees were placed in an almond orchard adjacent to an apricot orchard that had been treated with phosmet in a dormant spray (with oil) 3 to 7 days prior. Laboratory analysis confirmed that phosmet was the causative agent.

ECOLOGICAL RISK ASSESSMENT

To evaluate the potential risk to nontarget organisms from the use of phosmet products, risk quotients (RQs) are calculated from the ratio of estimated environmental concentrations (EEC) to ecotoxicity values. RQs are then compared to pre-established levels of concern (LOCs) for determination of potential ecorisk and the consideration of regulatory action.

a. Exposure and Risk to Nontarget Terrestrial Animals

For pesticides applied as a liquid product, the estimated environmental concentrations on food items following product application are compared to LC50 values to assess risk. The predicted 0-day maximum residues of a pesticide that may be expected to occur on selected avian or mammalian food items immediately following a direct single application at 1 lb ai/A are tabulated below and were derived from residue data reported in Fletcher (1994).

Estimated Environmental Concentrations (EECs) on Avian and Mammalian Food Items (ppm) Following a Single Application at 1 lb ai/A

Food Items	*EEC (ppm)*[1]
Short Grass	240
Tall Grass	110
Forage/Lg. Insects	135
Seeds	15

[1] Maximum EEC are for 1 lb ai/A application rate and are based on Fletcher *et al*. (1994).

i. *Birds*

a. Non-granular Products

In order to determine acute concerns for an avian species relative to phosmet use patterns, EFED has relied on the following calculations:

$$RQ = \frac{Instantaneous EEC}{LC50}$$

where the denominator represents the dietary LC50 for birds. Chronic toxicity values are based on the NOEC from reproductive studies. In order to evaluate chronic concerns, a maximum EEC was generated through a first- order kinetics model (rate of degradation = 0.0578). Chronic avian risk quotients were calculated by dividing this maximum EEC by the NOEC (max. EEC/NOEC).

The database used to assess the acute and chronic toxicity of phosmet to birds is complete. Phosmet is moderately to practically non-toxic to birds on an acute basis (840 - >5000 ppm). Residues on avian food items, immediately after application at maximum rates are expected to produce acute avian toxicity for all crops. However, a general exception is for those species that primarily consume seeds.

Regarding chronic effects, the concentration of phosmet that produces no reproductive effects (NOEC) is 60 ppm. However, the expected residue levels on avian food items (maximu EEC range: 16 - 1,463 ppm), if maintained over the duration of a breeding season (very possible with multiple applications), may exceed the LOC by a factor of 6. Based on RQs, all crops should be considered a high chronic risk to birds. The table below presents RQ values to support these conclusions.

Instantaneous EECs ranged from 15 to 1,440 ppm and the resultant acute RQ values ranged from 0.03 to 2.9. Levels of concern were exceeded from phosmet treatment of all crops where birds foraged in short or tall grasses and for birds foraging on small insects. Grainivores did not exceed levels of concern except in almonds apples, citrus and pears.

Acute and Chronic Avian Risk Quotients for Nontarget Avians from Phosmet Use on Various Crops

Crop	*App. Rate (lbs ai/A)*	*Food Item*	*Inst. EEC (ppm)*	*Max. EEC (ppm)*	*Chronic Tox. (ppm)*[1]	*Acute Tox. (ppm)*[1]	*RQ Chronic*	*RQ Acute*
Almonds	3.7(3)	Short grass	888	897	60	501	15.0[+]	1.8[xxx]
		Tall grass	407	411	60	501	6.8[+]	0.8[xxx]
		Forage/L. Insects	500	505	60	501	8.4[+]	1.0[xxx]
		Seeds	56	57	60	501	0.95	0.1[x]
Alfalfa	1(8)	Short grass	240	250	60	501	4.2*	0.5[xxx]
		Tall grass	110	114	60	501	1.9*	0.2[xx]
		Forage/L. Insects	135	140	60	501	2.3*	0.3[xx]
		Seeds	15	16	60	501	0.3	0.03
Apples (Western- high and Eastern high)	4(5)	Short grass	960	1197	60	501	19.9[+]	1.9[xxx]
		Tall grass	440	549	60	501	9.2[+]	0.9[xxx]
		Forage/L. Insects	540	673	60	501	11.2[+]	1.1[xxx]
		Seeds	60	75	60	501	1.25'	0.1[x]
Apples (Western- low and Eastern low)	1.5(10)	Short grass	360	449	60	501	7.5[+]	0.7[xxx]
		Tall grass	165	206	60	501	3.4[+]	0.3[xx]
		Forage/L. Insects	203	253	60	501	4.2[+]	0.5[xxx]
		Seeds	23	29	60	501	0.5	0.05
Berries	1(5)	Short grass	240	299	60	501	5.0[+]	0.5[xxx]
		Tall grass	110	137	60	501	2.3[+]	0.2[xx]
		Forage/L. Insects	135	168	60	501	2.8[+]	0.3[xx]
		Seeds	15	19	60	501	0.3	0.03
Cherries	1.75(4)	Short grass	420	523	60	501	8.7[+]	0.8[xxx]
		Tall grass	193	240	60	501	4.0[+]	0.4[xx]
		Forage/L. Insects	236	293	60	501	4.9[+]	0.5[xxx]
		Seeds	26	32	60	501	0.5	0.05
Citrus	2(3)	Short grass	480	480	60	501	8.0[+]	0.9[xxx]
		Tall grass	220	220	60	501	3.7[+]	0.4[xx]
		Forage/L. Insects	270	270	60	501	4.5[+]	0.5[xxx]
		Seeds	30	30	60	501	0.5	0.1[x]
Cotton	1(5)	Short grass	240	465	60	501	7.7[+]	0.5[xxx]
		Tall grass	110	213	60	501	3.5[+]	0.4[xx]
		Forage/L. Insects	135	261	60	501	4.3[+]	0.5[xxx]
		Seeds	15	29	60	501	0.5	0.03
Grapes	1.5(4)	Short grass	360	364	60	501	6.1[+]	0.72[xxx]
		Tall grass	165	167	60	501	2.8[+]	0.33[xx]
		Forage/L. Insects	203	205	60	501	3.4[+]	0.41[xx]
		Seeds	23	23	60	501	0.4	0.05
Kiwi	2(6)	Short grass	480	500	60	501	8.3[+]	1.0[xxx]
		Tall grass	220	229	60	501	3.8[+]	0.4[xx]
		Forage/L. Insects	270	281	60	501	4.7[+]	0.5[xxx]
		Seeds	30	31	60	501	0.5	0.06
Peaches– High	3(4)	Short grass	720	897	60	501	15[+]	1.4[xxx]
		Tall grass	330	411	60	501	6.9[+]	0.7[xxx]
		Forage/L. Insects	405	504	60	501	8.4[+]	0.8[xxx]
		Seeds	45	56	60	501	0.9	0.09

Crop	*App. Rate (lbs ai/A)*	*Food Item*	*Inst. EEC (ppm)*	*Max. EEC (ppm)*	*Chronic Tox. (ppm)[1]*	*Acute Tox. (ppm)[1]*	*RQ Chronic*	*RQ Acute*
Peaches–Low	2(5)	Short grass	480	599	60	501	10+	1.0xxx
		Tall grass	220	274	60	501	4.6+	0.4xx
		Forage/L. Insects	270	337	60	501	5.6+	0.5xxx
		Seeds	30	37	60	501	0.6	0.06
Pears	5(3)	Short grass	1,200	1,209	60	501	20+	2.4xxx
		Tall grass	550	554	60	501	9.2+	1.1xxx
		Forage/L. Insects	675	680	60	501	11+	1.3xxx
		Seeds	75	76	60	501	1.3+	0.2xx
Pecans	2.25(5)	Short grass	540	549	60	501	9.2+	1.1xxx
		Tall grass	248	252	60	501	4.2+	0.5xxx
		Forage/L. Insects	304	309	60	501	5.2+	0.6xxx
		Seeds	34	35	60	501	0.6	0.07
Plums/Prunes	3(5)	Short grass	720	750	60	501	13+	1.4xxx
		Tall grass	330	344	60	501	5.7+	0.7xxx
		Forage/L. Insects	405	405	60	501	6.8+	0.8xxx
		Seeds	45	47	60	501	0.8	0.09
Potatoes	1(5)	Short grass	240	266	60	501	4.4+	0.5xxx
		Tall grass	110	122	60	501	2.0+	0.2xx
		Forage/L. Insects	135	150	60	501	2.5+	0.3xx
		Seeds	15	17	60	501	0.3	0.03
Walnuts	6(5)	Short grass	1,440	1,463	60	501	24+	2.9xxx
		Tall grass	660	670	60	501	11+	1.3xxx
		Forage/L. Insects	810	823	60	501	14+	1.6xxx
		Seeds	90	91	60	501	1.5+	0.2xx

1) Bobwhite quail LC50 = 501 ppm; Bobwhite quail NOEC = 60 ppm.

xxx exceeds acute high, acute restricted and acute endangered species LOCs.
xx exceeds acute restricted and acute endangered species LOCs.
x exceeds the endangered species LOC.
\+ exceeds chronic risk LOC.

ii. Mammals

Estimating the potential for adverse effects to wild mammals is based upon EFED's draft 1995 SOP of mammalian risk assessments and methods used by Hoerger and Kenaga (1972) as modified by Fletcher *et al.*, (1994). The concentration of phosmet in the diet that is expected to be acutely lethal to 50% of the test organisms (LC_{50}) is determined by dividing the LD50 value (usually the rat LD50) by the per cent body weight consumed. A risk quotient is then determined by dividing the EEC by the modified LC50 value.

$$RQ = \frac{\text{EEC (ppm)}}{\text{LD50 (mg/kg) / \% Body weight Consumed}}$$

Risk quotients are calculated for four different kinds of food (short grass, tall grass, forage/insects, and seeds) that are expected to be consumed by mammalian herbivores, insectivores, and granivores. The per cent body weight consumed for herbivores and insectivores corresponding to three weight categories (15, 35, and 1000 g) is assumed to be 95%, 66%, and 15%, respectively. Granivores are expected to have a different per cent body weight consumption for the same weight categories (21%, 15%, and 3%, respectively). Chronic toxicity values were based on the lowest effect level (LEL) from a rat reproductive study. In order to evaluate chronic concerns, a maximum EEC was generated for each crop and food item through the FATE model that takes into consideration pesticide half life, application rate, number of applications, and interval between applications (first order kinetics model). Chronic mammalian RQ values were calculated by dividing the maximum EEC by the LEL.

Although, phosmet appears to be moderately toxic to mammals on an acute basis, application rates (especially multiple applications) can result in residues on food items capable of producing toxic effects. Phosmet exposure to mammalian herbivores and insectivores may exceed acute high toxicity, acute restricted use triggers, and acute endangered species concerns in all registered crops. However, those species that feed on seeds (granivores) do not appear to have the same risk of acute toxicity as those feeding more on insects, forage and grasses.

Risk Quotients for chronic effects to mammals showed that phosmet exposure can result in values that are about 20 times greater than any of the levels of concern in all crops. Even though phosmet is not considered to be a persistent compound ($t_{1/2}$ = 3 days), the application rates and frequency of applications may result in residues that trigger toxicity concerns for a wide range of mammalian species.

Risk quotients exceeded levels of concern for mammals foraging on short and tall grass and for animals foraging on small insects. For small mammals, averaging 15- 35 g, phosmet treatment in all crops represented an acute high risk. In larger mammals averaging 1 kg and foraging in short grass, phosmet treatment resulted in an acute high risk on all crops except alfalfa and potatoes. In larger mammals foraging in tall grass or insects, phosmet represented an acute restricted use level of concern for most crops; exceptions were phosmet use on almonds, apples (high), peaches (high) pears, plums and walnuts where phosmet use represented an acute high risk. Granivores were the least affected; levels of concern were only exceeded following treatment to almonds, pears and walnuts. Phosmet use represented a chronic risk to all mammals in all forage areas except for granivores foraging around cherry orchards and potato fields treated with phosmet.

iii. Insects

Currently, EFED does not assess risk to nontarget insects; however, the results of acceptable studies can be used for recommending appropriate label precautions. Relative to phosmet exposure, a bee contact LD_{50} study indicated that the compound is very highly toxic. In addition, incident reports of bee mortality in California and North Carolina were attributed to phosmet. The importance of bee pollination can have a direct impact on agriculture (several billion dollars) since bees are fundimental to about one-third of the U.S. agricultural system. Bees pollinate several varieties of fruit and vegetables including crops registered for phosmet use, orchards and alfalfa. Based on phosmet’s toxicity to nontarget insects and the incidence reports, a precautionary label to protect bees is required.

Acute Risk Quotients for Nontarget Mammalians (Herbivore, Insectivore, Granivore) from Phosmet Use on Various Crops

CropApp. Rate(lbs ai/A)App. No.(Days)	*BodyWt. (g)*	*% Body Wt. Consumed*	*EEC (ppm) Short Grass*	*EEC (ppm) Tall Grass*	*EEC (ppm) forage, Lg. Insects*	*EEC (ppm) Seed*	*Tox Acute (ppm)*	*RQ Short Grass*	*RQ Tall Grass*	*RQ Forage Lg. Insects*	*RQ Seeds*
Almonds3.7(3)	15	95; 21	897	411	505	57	113	7.5[xxx]	3.5[xxx]	4.2[xxx]	0.11[x]
	35	66; 15						5.2[xxx]	2.4[xxx]	3.0[xxx]	0.08
	1000	15; 3						1.2[xxx]	1.6[xxx]	0.7[xxx]	0.02
Alfalfa 1(8)	15	95;21	240	110	135	15	113	2.0[xxx]	0.9[xxx]	1.1[xxx]	0.03
	35	66;15						1.4[xxx]	0.6[xxx]	0.8[xxx]	0.02
	1000	15; 3						0.3[xx]	0.1[x]	0.2[xx]	0.00
Apples(Weastern and eastern High) 4(5)	15	95; 21	960	440	540	60	113	8.1[xxx]	3.4[xxx]	4.5[xxx]	0.11[x]
	35	66; 15						5.6[xxx]	2.6[xxx]	3.2[xxx]	0.08
	1000	15; 3						1.3[xxx]	0.6[xxx]	0.7[xxx]	0.02
Apples (Western and Eastern Low)1.5(10)	15	95; 21	360	165	203	23	113	3.0[xxx]	1.4[xxx]	1.7[xxx]	0.04
	35	66; 15						2.1[xxx]	1.0[xxx]	1.2[xxx]	0.03
	1000	15; 3						0.5[xxx]	0.2[xx]	0.3[xx]	0.01
Berries1(5)	15	95; 21	240	110	135	15	113	2.0[xxx]	0.9[xxx]	1.1[xxx]	0.03
	35	66; 15						1.4[xxx]	0.6[xxx]	0.8[xxx]	0.02
	1000	15; 3						0.3[xx]	0.1[x]	0.2[xx]	0.00
Cherries1.75(4)	15	95; 21	420	193	236	26	113	3.5[xxx]	1.6[xxx]	2.0[xxx]	0.05
	35	66; 15						2.5[xxx]	1.1[xxx]	1.4[xxx]	0.03
	1000	15; 3						0.6[xxx]	0.3[xx]	0.3[xx]	0.01
Citrus2(3)	15	95; 21	480	220	270	30	113	4.0[xxx]	1.8[xxx]	2.3[xxx]	0.06
	35	66; 15						2.8[xxx]	1.3[xxx]	1.6[xxx]	0.04
	1000	15; 3						0.6[xxx]	0.3[xx]	0.4[xx]	0.01
Grapes1.5(4)	15	95; 21	360	165	203	23	113	3.0[xxx]	1.4[xxx]	1.7[xxx]	0.04
	35	66; 15						2.1[xxx]	1.0[xxx]	1.2[xxx]	0.03
	1,000	15; 3						0.5[xxx]	0.2[xx]	0.3[xx]	0.01
Kiwi 2(6)	15	95; 21	480	220	270	30	113	4.0[xxx]	1.9[xxx]	2.3[xxx]	0.06
	35	66; 15						2.8[xxx]	1.3[xxx]	1.6[xxx]	0.04
	1,000	15; 3						0.6[xxx]	0.3[xx]	0.4[xx]	0.01
Peaches-High 3(4)	15	95; 21	720	330	405	45	113	6.1[xxx]	2.8[xxx]	3.4[xxx]	0.08
	35	66; 15						4.2[xxx]	1.9[xxx]	2.4[xxx]	0.06
	1,000	15; 3						1.0[xxx]	0.4[xx]	0.5[xxx]	0.01
Peaches-Low 2(5)	15	95; 21	480	220	270	30	113	4.0[xxx]	1.8[xxx]	2.3[xxx]	0.06
	35	66; 15						2.8[xxx]	1.3[xxx]	1.6[xxx]	0.04
	1,000	15; 3						0.6[xxx]	0.3[xx]	0.4[xx]	0.01
Pears 5(3)	15	95; 21	1,200	550	675	75	113	10[xxx]	4.6[xxx]	5.7[xxx]	0.1[x]
	35	66; 15						7.0[xxx]	3.2[xxx]	3.9[xxx]	0.1[x]
	1,000	15; 3						1.6[xxx]	0.7[xxx]	0.9[xxx]	0.02

CropApp. Rate (lbs ai/A) App. No. (Days)	*BodyWt. (g)*	*% Body Wt. Consumed*[2]	*EEC (ppm) Short Grass*	*EEC (ppm) Tall Grass*	*EEC (ppm) forage, Lg. Insects*	*EEC (ppm) Seed*	*Tox. Acute (ppm)*	*RQ Short Grass*	*RQ Tall Grass*	*RQ Forage Lg. Insects*	*RQ Seeds*
Pecans 2.25(5)	15	95; 21	540	248	304	34	113	4.5[xxx]	2.1[xxx]	2.6[xxx]	0.06
	35	66; 15						3.2[xxx]	1.5[xxx]	1.8[xxx]	0.05
	1,000	15; 3						0.7[xxx]	0.3[xx]	0.4[xx]	0.01
Plums/Prunes 3(5)	15	95; 21	720	330	405	45	113	6.1[xxx]	2.8[xxx]	3.4[xxx]	0.08
	35	66; 15						4.2[xxx]	1.9[xxx]	2.4[xxx]	0.06
	1,000	15; 3						1.0[xxx]	0.4[xx]	0.5[xxx]	0.01
Potatoes 1(5)	15	95; 21	240	110	135	15	113	2.0[xxx]	0.9[xxx]	1.1[xxx]	0.03
	35	66; 15						1.4[xxx]	0.6[xxx]	0.8[xxx]	0.02
	1,000	15; 3						0.3[xx]	0.2[xx]	0.2[xx]	0.004
Potatoes, Sweet 1(5)	15	95; 21	240	110	135	15	113	2.0[xxx]	0.9[xxx]	1.1[xxx]	0.03
	35	66; 15						1.4[xxx]	0.6[xxx]	0.8[xxx]	0.02
	1,000	15; 3						0.3[xx]	0.2[xx]	0.2[xx]	0.004
Walnuts 6(5)	15	95; 21	1,440	660	810	90	113	12[xxx]	5.5[xxx]	6.8[xxx]	0.2[xx]
	35	66; 15						8.4[xxx]	3.9[xxx]	4.7[xxx]	0.1[x]
	1,000	15; 3						1.9[xxx]	0.9[xxx]	1.1[xxx]	0.02

Mammalian Chronic Risk Quotients for Multiple Applications of Phosmet to Various Crops

Crop *App. Rate (lbs ai/A)* *No. App. (Days)*	*Food Item*	*Maximum EEC (ppm)*[1]	*Toxicity (ppm)*[2]	*RQ*[3]
Almonds	Short grass	897	20	44.85[+]
3.7(3)	Tall grass	411	20	20.55[+]
	Forage/ L. Insects	504	20	25.20[+]
	Seeds	57	20	2.85[+]
	Short grass	250	20	12.5[+]
Alfalfa	Tall grass	114	20	5.7[+]
1(8)	Forage/L. Insects	140	20	7.00[+]
	Seeds	16	20	0.80
	Short grass	1197	20	59.85[+]
Apples (Western and Eastern High)	Tall grass	549	20	27.45[+]
4(5)	Forage/L. Insects	673	20	33.65[+]
	Seeds	75	20	--
	Short grass	449	20	22.45[+]
Apples (Western and Eastern Low)	Tall grass	206	20	10.30[+]
1.5(10)	Forage/L. Insects	253	20	12.65[+]
	Seeds	28	20	1.4[+]
	Short grass	299	20	14.95[+]
Berries	Tall grass	137	20	6.85[+]
1(5)	Forage/L. Insects	168	20	8.40[+]
	Seeds	19	20	0.95
	Short grass	523	20	26.15[+]
Cherries	Tall grass	240	20	12.00[+]
1.75(4)	Forage/L.Insects	293	20	14.65[+]
	Seeds	32	20	1.60[+]
	Short grass	480	20	24.00[+]
Citrus	Tall grass	220	20	11.00[+]
2(3)	Forage/L. Insects	270	20	13.50[+]
	Seeds	30	20	1.50[+]
	Short grass	500	20	25.00[+]
Kiwi	Tall grass	229	20	11.45[+]
2(6)	Forage/ L. Insects	281	20	14.10[+]
	Seeds	31	20	1.55[+]
	Short grass	363	20	18.15[+]
Grapes	Tall grass	167	20	8.35[+]
1.5(4)	Forage/ L. Insects	205	20	10.25[+]
	Seeds	23	20	1.15[+]
	Short grass	897	20	44.85[+]
Peaches High	Tall grass	411	20	20.55[+]
3(4)	Forage/ L. Insects	504	20	25.20[+]
	Seeds	56	20	2.80[+]
	Short grass	599	20	29.95[+]
Peaches–Low	Tall grass	274	20	13.70[+]
2(5)	Forage/ L. Insects	337	20	16.85[+]
	Seeds	37	20	1.85[+]
	Short grass	1,209	20	60.45[+]
Pears	Tall grass	554	20	27.70[+]
5(3)	Forage/ L. Insects	680	20	34.00[+]
	Seeds	76	20	3.80[+]

Crop App. Rate (lbs ai/A) No. App. (Days)	*Food Item*	*Maximum EEC (ppm)*	*Toxicity (ppm)*	*RQ*
	Short grass	549	20	27.45^{+}
Pecans	Tall grass	252	20	12.60^{+}
2.25(5)	Forage/ L. Insects	309	20	15.45^{+}
	Seeds	35	20	1.75^{+}
	Short grass	750	20	37.50^{+}
Plums/Prunes	Tall grass	344	20	17.20^{+}
3(5)	Forage/ L. Insects	405	20	20.25^{+}
	Seeds	47	20	2.35^{+}
	Short grass	266	20	13.30^{+}
Potatoes	Tall grass	122	20	6.10^{+}
1(5)	Forage/ L. Insects	150	20	7.50^{+}
	Seeds	17	20	0.85
	Short grass	266	20	13.30^{+}
Sweet Potatoes	Tall grass	122	20	6.10^{+}
1(5)	Forage/ L. Insects	150	20	7.50^{+}
	Seeds	17	20	0.85
	Short grass	1,463	20	73.15^{+}
Walnuts	Tall grass	670	20	33.50^{+}
6(5)	Forage/ L. Insects	823	20	41.15^{+}
	Seeds	90	20	4.50^{+}

1) Maximum EEC values were calculated through the FATE model that calculates degradation and multiple applications relative to time.
2) Rat LEL = 20 ppm.
3) Chronic RQ values were calculated for mammalians relative to the different food groups and estimated environmental concentrations of phosmet for various crops. RQ = Maximum EEC (ppm)/ Chronic Toxicity (ppm). The chronic mammalian toxicity value that was used to calculate chronic RQ values for mammalians was the laboratory rat LEL = 20 ppm.

b. Exposure and Risk to Nontarget Aquatic Animals

Estimated Environmental Concentrations (EECs) in aquatic environments, specifically, edge-of-field ponds, using PRZM-EXAMS are presented in the following table. The Pesticide Root Zone Model (PRZM3.1) simulates pesticide field runoff on daily time steps and incorporates the effects due to runoff, infiltration, erosion, and evaporation. The model calculates foliar dissipation and runoff, plant uptake, microbial transformation, volatilization, and soil dispersion and retardation. The Exposure Analysis Modeling System (EXAMS 2.97.5) simulates pesticide fate and transport in an aquatic environment.

Environmental fate studies indicate that phosmet will tend to sorb to sediments and soils. Monitoring studies conducted in 1990 in the Columbia Basin, Umatilla, Oregon, suggest that phosmet will tend to be higher in benthic sediments than dissolved or sorbed to suspended material in the pelagic zone. Concentrations in sediments may pose a greater risk to aquatic organisms because of this behavior.

PRZM/EXAMS Surface Water Concentrations for Phosmet (PPB). 1 in 10 Years Concentrations Except Mean

Crop	*Peak*	*4-Day*	*21-Day*	*60-day*	*90-day*	*90% CB Mean**
Alfalfa	3.0	0.60	0.20	0.10	0.10	0.06
Almonds	10.3	1.30	0.50	0.20	0.10	0.08
Apples, Eastern-high	26.7	5.00	1.40	0.80	0.50	0.20
Apples, Eastern-low	15.6	2.10	0.60	0.30	0.30	0.09
Apples, Western-high	11.2	1.50	0.80	0.50	0.30	0.10
Apples, Western-low	0.4	0.10	0.03	0.03	0.02	0.01
Berries	11.8	1.60	0.40	0.20	0.10	0.03
Cherries	9.5	1.80	0.60	0.30	0.20	0.06
Citrus	12.9	1.90	0.60	0.30	0.20	0.06
Cotton	29.9	4.40	1.00	0.40	0.20	0.09
Grapes	18.7	4.20	1.00	0.60	0.40	0.20
Kiwi	137.3	17.10	3.90	2.50	1.70	1.00
Peaches-high	16.2	2.70	1.00	0.50	0.30	0.10
Peaches-low	8.9	1.70	0.50	0.20	0.20	0.05
Pears	140.0	17.70	3.70	3.60	2.40	1.00
Pecans	23.7	3.30	0.80	0.40	0.30	0.09
Plums	8.4	1.00	0.40	0.40	0.20	0.10
Potatoes	7.9	1.20	0.50	0.20	0.20	0.05
Potatoes, sweet	20.6	3.50	1.00	0.40	0.30	0.09
Walnuts	8.4	1.00	0.40	0.30	0.20	0.10

i. Aquatic Organisms (Acute and Chronic)

Fish: Based upon laboratory data, phosmet has the potential for very high acute toxicity to freshwater and marine/estuarine species (LC50; 0.07 and 0.17 ppm, respectively). According to the exposure model results (PRZM/EXAMS), acute risk is a possibility for freshwater fish, resulting in the "Restrictive Use" category for all crops. Acute risk appears to be reduced for marine/estuarine species with the exception of possible exposure from phosmet treatment on apples (eastern high).

Given the chronic toxicity values for phosmet in freshwater and marine fish, i.e., NOECs of 3.2 and 2.4 ppb, respectively, it is reasonable to expect high. In spite of the high chronic toxicity of phosmet to both freshwater and marine/estuarine fish, trigger environmental concentrations (PRZM/EXAMS) for most crops were not exceeded for fish. Exceptions occur with kiwi, pears and apples (high) for marine/estuarine fish and for pears alone for freshwater fish.

Aquatic Invertebrates: The acute toxicity of phosmet to freshwater and marine/estuarine invertebrates is very high, i.e., LC50 of 2 ppb and 16 ppb, respectively. EECs ranged over four orders of magnitude (0.03 - 140 ppb) and suggest the possibility of acute poisoning of aquatic invertebrates relative to all crops.

Chronic concern for freshwater invertebrates was most prevalent on orchard crops, most notably apples (western and eastern low), grapes, kiwi, peaches (high), pears, and pecans. All crops appear to result in a chronic concern for marine/estuarine invertebrates with the exception of alfalfa and cherries.

Freshwater Aquatic Organisms Acute and Chronic Risk Quotients for Multiple Application of Phosmet to Various Crops

Crop App. Rate (lbs ai/A), App. No. (Days)	*Organism*	*LC_{50} (ppb)*[1]	*NOEC (ppb)*[2]	*EEC Peak (ppb)*[3]	*EEC 60-Day and 21-Day Ave. (ppb)*[4]	*Acute RQ (EEC/LC50)*[5]	*Chronic RQ*[6] *(EEC/NOEC)*
Almonds 3.7(3)	Fish	70	3.2	10.3	0.20	0.14[xx]	0.06
	Invertebrates	2.0	0.75	10.3	0.50	5.15[xxx]	0.67
Alfalfa 1(8)	Fish	70	3.2	3.0	0.10	0.04	0.03
	Invertebrates	2.0	0.75	3.0	0.20	1.5[xxx]	0.27
Apples (Eastern High) 4(5)	Fish	70	3.2	26.7	0.80	0.40[xx]	0.25
	Invertebrates	2.0	0.75	26.7	1.40	13.4[xxx]	1.87[+]
Apples (Eastern Low) 1.5(10)	Fish	70	3.2	15.6	0.30	0.22[xx]	0.09
	Invertebrates	2.0	0.75	15.6	0.60	7.8[xxx]	0.80
Apples (Western High) 4(5)	Fish	70	3.2	11.2	0.50	0.16[xx]	0.15
	Invertebrates	2.0	0.75	11.2	0.80	5.6[xxx]	1.07[+]
Apples (Western Low) 1.5(10)	Fish	70	3.2	0.4	0.03	0.01	0.01
	Invertebrates	2.0	0.75	0.4	0.03	0.2[xx]	0.04
Berries 1(5)	Fish	70	3.2	11.8	0.20	0.17[xx]	0.06
	Invertebrates	2.0	0.75	11.8	0.40	5.9[xxx]	0.53
Cherries 1.75(4)	Fish	70	3.2	9.5	0.30	0.14[xx]	0.09
	Invertebrates	2.0	0.75	9.5	0.60	4.75[xxx]	0.80
Citrus 2(3)	Fish	70	3.2	12.9	0.30	0.18[xx]	0.09
	Invertebrate	2.0	0.75	12.9	0.60	6.45[xxx]	0.80
Grapes 1.5(4)	Fish	70	3.2	18.7	0.6	0.27[xx]	0.19
	Invertebrate	2.0	0.75	18.7	1.0	9.4[xxx]	1.3[+]
Kiwi 2(6)	Fish	70	3.2	137.3	2.5	1.96[xxx]	0.78
	Invertebrate	2.0	0.75	137.3	3.9	68.7[xxx]	5.2[+]
Peaches–High 3(4)	Fish	70	3.2	16.2	0.5	0.23[xx]	0.16
	Invertebrate	2.0	0.75	16.2	1.0	8.1[xxx]	1.33[+]
Peaches–Low 2(5)	Fish	70	3.2	8.9	0.2	0.13[xx]	0.06
	Invertebrate	2.0	0.75	8.9	0.5	4.45[xxx]	0.67
Pears 5(3)	Fish	70	3.2	140	3.6	2.0[xxx]	1.13[+]
	Invertebrate	2.0	0.75	140	3.7	70[xxx]	4.9[+]
Pecans 2.25(5)	Fish	70	3.2	23.7	0.4	0.34[xx]	0.13
	Invertebrate	2.0	0.75	23.7	0.8	11.9[xxx]	1.1[+]

Crop App.Rate (lbs ai/A), App.No (days)	*Organisms*	*LC_{50} (ppb)[1]*	*NOEC (ppb)[2]*	*EEC Peak (ppb)[3]*	*EEC 60-Day and 21-Day Ave. (ppb)[4]*	*Acute RQ (EEC/LC50)[5]*	*Chronic RQ[6] (EEC/NOEC)*
Potatoes 1(5)	Fish	70	3.2	8.4	0.2	0.12[xx]	0.06
	Invertebrate	2.0	0.75	8.4	0.5	4.2[xxx]	0.67
Sweet Potatoes 1(5)	Fish	70	3.2	8.4	0.4	0.12[xx]	0.13
	Invertebrate	2.0	0.75	8.4	1.0	4.2[xxx]	1.33[+]
Plums/Prunes 3(5)	Fish	70	3.2	8.4	0.4	0.12[xx]	0.13
	Invertebrate	2.0	0.75	8.4	0.4	4.2[xxx]	0.53
Walnuts 6(5)	Fish	70	3.2	8.4	0.3	0.12[xx]	0.09
	Invertebrates	2.0	0.75	8.4	0.4	4.2[xxx]	0.53

1) Bluegill sunfish LC50 = 70 ppb; Gammarus fasciatus LC50 = 2.0 ppb
2) Rainbowtrout NOEC = 3.2 ppb; Daphnia NOEC = 0.75 ppb.
3) Peak EEC values derived through PRZM/EXAMS modeling.
4) For each crop, two PRZM/EXAMS EEC values are provided: the upper value reprsents the 60-day EEC value used in calculating chronic RQ values for fish; the lower value represents the 21-day EEC value used in calculating chronic RQ values for invertebrates.
5) Acute RQ values were calculated by dividing the peak EEC by the LC50.
6) Chronic RQ values for fish were calculated by dividing the 60-day EEC by the NOEC; chronic RQ values for invertebrates were calculated by dividing the 21-day EEC by the NOEC.

Marine/Estuarine Aquatic Organisms Acute and Chronic Risk Quotients for Multiple Applications

Crop App. Rate (lbs ai/A) App. No (Days)	*Organism*	*LC_{50} (ppb)*[1]	*NOEC (ppb)*[2]	*EEC Peak (ppb)*[3]	*EEC 60- Day and 21-Day Ave. (ppb)*[4]	*Acute RQ (EEC/LC_{50})*[5]	*Chronic RQ (EEC/NOEC)*[6]
Almonds 3.7(3)	Fish	170	2.36	10.3	0.20	0.06[x]	0.08
	Invertebrates	16	0.37	10.3	0.50	0.64[xxx]	1.35[+]
Alfalfa 1(8)	Fish	170	2.36	3.0	0.10	0.02	0.04
	Invertebrates	16	0.37	3.0	0.20	0.19[xx]	0.39
Apples (Eastern High) 4(5)	Fish	170	2.36	26.7	8.0	0.16[xx]	3.4[+]
	Invertebrates	16	0.37	26.7	1.40	1.67[xxx]	2.74[+]
Apples (Eastern Low) 1.5(10)	Fish	170	2.36	15.6	0.30	0.09[x]	0.13
	Invertebrates	16	0.37	15.6	0.60	1.0[xxx]	1.62[+]
Apples (Western High) 4(5)	Fish	170	2.36	11.2	0.50	0.06[x]	0.21
	Invertebrates	16	0.37	11.2	0.80	0.70[xxx]	2.16[+]
Apples (Western Low) 1.5(10)	Fish	170	2.36	0.4	0.03	0.00	0.01
	Invertebrates	16	0.37	0.4	0.03	0.25[xx]	0.08
Berries 1(5)	Fish	170	2.36	11.8	0.20	0.07[x]	0.08
	Invertebrates	16	0.37	11.8	0.40	0.74[xxx]	1.08[+]
Cherries 1.75(4)	Fish	170	2.36	9.5	0.30	0.06[x]	0.13
	Invertebrates	16	0.37	9.5	0.60	0.59[xxx]	0.16
Citrus 2(3)	fish	170	2.36	12.9	0.30	0.00	0.13
	Invertebrates	16	0.37	12.9	0.60	0.81[xxx]	1.62[+]
Grapes 1.5(4)	fish	170	2.36	18.7	0.6	0.11[xx]	0.25
	Invertebrates	16	0.37	18.7	1.0	1.17[xxx]	2.70[+]
Kiwi 2(6)	fish	170	2.36	137.3	2.5	0.8[xxx]	1.06[+]
	Invertebrates	16	0.37	137.3	3.9	9.4[xxx]	10.5[+]
Peaches–High 3(4)	Fish	170	2.36	16.2	0.50	0.1[xx]	0.21
	Invertebrates	16	0.37	16.2	1.00	1.0[xxx]	2.70[+]
Peaches–Low 2(5)	Fish	170	2.36	8.9	0.2	0.05[x]	0.08
	Invertebrates	16	0.37	8.9	0.5	0.6[xxx]	1.35[+]

Crop App. Rate (lbs ai/A) App. No (Days)	*Organism*	*LC_{50} (ppb)1*	*NOEC (ppb)[2]*	*EEC Peak (ppb)[3]*	*EEC 60- Day and 21-Day Ave. (ppb)[4]*	*Acute RQ (EEC/LC_{50})[5]*	*Chronic RQ (EEC/NOEC)[6]*
Peaches–High 3(4)	Fish	170	2.36	16.2	0.50	0.1[xx]	0.21
	Invertebrates	16	0.37	16.2	1.00	1.0[xxx]	2.70[+]
Peaches–Low 2(5)	Fish	170	2.36	8.9	0.2	0.05[x]	0.08
	Invertebrates	16	0.37	8.9	0.5	0.6[xxx]	1.35[+]
Pears 5(3)	Fish	170	2.36	140	3.6	0.8[xxx]	1.52[+]
	Invertebrates	16	0.37	140	3.7	8.8[xxx]	10[+]
Pecans 2.25(5)	Fish	170	2.36	23.7	0.4	0.1[xx]	0.17
	Invertebrates	16	0.37	23.7	0.8	1.5[xxx]	2.16[+]
Plums/Prunes 3(5)	Fish	170	2.36	8.4	0.4	0.05[x]	0.17
	Invertebrates	16	0.37	8.4	0.4	0.53[xxx]	1.08[+]
Potatoes 1(5)	Fish	170	2.36	7.9	0.2	0.05[x]	0.08
	Invertebrates	16	0.37	7.9	0.5	0.5[xxx]	1.35[+]
Sweet Potatoes 1(5)	Fish	170	2.36	21	0.4	0.1[xx]	0.17
	Invertebrates	16	0.37	21	1.0	1.3[xxx]	2.70[+]
Walnuts 6(5)	Fish	170	2.36	8.4	0.3	0.05[x]	0.13
	Invertebrates	16	0.37	8.4	0.4	0.5[xxx]	1.1[+]

1) Sheepshead minnow LC50 = 170 ppb; Mysid shrimp LC50 = 16 ppb.
2) Since a NOEC for marine fish was not available, an extrapolation was calculated based on the rainbow trout chronic to acute ratio. Acute values for rainbow trout were calculated at 250 ppb (150 - 350 ppb) and the NOEC at 4.4 ppb, while the marine/estuarine fish, sheepshead minnow, had an LC50 of 170 ppb. Since the sheepshead minnow acute toxicity value is within the rainbow trout 95% confidance interval, a NOEC of 2.36 ppb was calculated for marine fish.
3) Peak EEC values were derived through PRZM/EXAMS modeling.
4) For each crop, two PRZM/EXAMS EEC values are provided: the upper value represents the 60-day EEC value used in calculating chronic RQ values for fish; the lower value represents the 21-day EEC value used in calculating chronic RQ values for invertebrates.
5) Acute RQ values were calculated by dividing the peak EEC by the LC50.
6) Chronic RQ values for fish were calculated by dividing the 60-day EEC by the NOEC; chronic RQ values for invertebrates were calculated by dividing the 21-day EEC by the NOEC.

c. Exposure and Risk to Endangered Species

The Agency has developed a program (the "Endangered Species Protection Program") to identify pesticides that may cause adverse impacts on endangered and threatened species, and to implement mitigation measures that will eliminate the adverse impacts. At present, the program is being implemented on an interim basis as described in a Federal Register notice (54 FR 27984-28008, July 3, 1989), and is providing information to pesticide users to help them protect these species on a voluntary basis. As currently planned, the final program will call for label modifications referring to required limitations on pesticide uses, typically as depicted in county-specific bulletins or by other site-specific mechanisms as specified by state partners. A final program, which may be altered from the interim program, will be described in a future Federal Register notice. The Agency is not imposing label modifications at this time through the RED. Rather, any requirements for product use modifications will occur in the future under the Endangered Species Protection Program.

RISK CHARACTERIZATION

The risk quotients on the previous pages indicate that acute and chronic risks to wildlife and aquatic organisms may result from all uses of phosmet. While the acute testing of avian and mammalian species suggests moderate to low toxicity, the high application rates and frequency of application leads to exposure levels that trigger significant concern. In the case of fish (freshwater and marine/estuarine), acute and chronic toxicity testing show that phosmet is highly to very highly toxic, but risk appears to be somewhat less than expected, possibly a result of degradation on soil and in the water column through hydrolysis and biodegradation. However, this is not the case for aquatic invertebrates (freshwater and marine/estuarine). Acute and chronic toxicity testing of these organisms show the potential for very high toxicity as well as very high acute and chronic risk from exposure to this compound after use on all crops.

Since several registered uses of phosmet include crops (apples, cherries, almonds, pears, peaches, plums, alfalfa, etc.) that rely on pollination by honey bees, risk to honey bees appears to be very high if phosmet is used in or around these crops. Incidents of bee kills have been reported with direct evidence of phosmet exposure. Since, bees are fundamental to about one-third of the U.S. agricultural system, the pollination provided by these organisms can have a direct impact on agriculture that can amount to $20 billion a year.

Although acute and chronic effects data are used in the estimation of risk to aquatic and terrestrial organisms, these values have a great deal of uncertainty associated with them. An LC50, denoting that 50% mortality of a population as an acceptable risk, may be grossly underestimating the hazards to species in the field where 10 or 20% mortality may be an upper limit to population survival. This uncertainty factor is expanded if we consider that estimates of avian and mammalian dietary exposure may be understated when toxicity values, based on dry laboratory diet values, are compared to wet weight residue levels. This is relevant because these organisms eating their natural diet in the field need to consume a higher proportion of their body weight compared to comparable animals consuming laboratory food with a low moisture content in order to obtain the same level of energy. Relative to the uncertainties surrounding hazard evaluation of avians and mammals to phosmet exposure, the use of Fletcher's maximum EECs in estimating this hazard may actually underestimate the total risk. Therefore, when RQs exceed the level of concern by a factor of 6 (avian chronic) or 20 (mammalian chronic), and mitigation actions are not an option because of efficacy and use pattern concerns, the continued use of that chemical in such areas like orchards (almonds, apples, cherries, citrus, kiwi, peaches, pears, pecans, plums, walnuts) should be seriously questioned.

Additionally, the risk to terrestrial organisms may be underestimated based on the single half-life value used to estimate EECs. Phosmet is subject to rapid hydrolysis under alkaline and neutral conditions. Microbial mediated degradation is also a major route of dissipation. In soils where microbial activity is minimal, leaching may be a significant route of dissipation for the chemical. Phosmet degrades rapidly (half-life, $t_{1/2}$=3 days) under aerobic conditions in soil, and more slowly under anaerobic conditions ($t_{1/2}$=15 days). Phosmet was not detected below the 10.5-inch soil layer in any of three field dissipation studies and dissipated to or below the level of detection (LOD) prior to the study's completion. The half-life used to estimate exposure and risk to terrestrial organisms was up to six times faster than half-lives observed in the three field studies. Therefore, it is likely that the risk to terrestrial organisms may be underestimated using the shorter half-life from the single aerobic soil metabolism study.

Phosmet oxon, the only known degradate of toxicological concern, was identified in a number of the environmental fate studies conducted. Phosmet oxon appears to be less mobile than phosmet, as evidenced by its absence in leachates in the aged and unaged mobility study. In addition, phosmet oxon was limited to the upper soil layer in the field studies while phosmet was detected as low as the 10.5-inch soil layer. Phosmet oxon was not specifically identified in the soil leachate of the aged mobility study; in the aerobic or anaerobic soil metabolism studies, phosmet oxon was identified in very small amounts relative to the parent and other degradates. The pattern of formation and decline of phosmet oxon was not characterized well enough to formulate a full fate assessment.

Based on the laboratory and field studies conducted, phosmet and phosmet oxon would appear to pose a threat to groundwater resources underlaying vulnerable soils. However, the relatively short half-life should reduce migration in most microbially active soils. Phosmet and possibly phosmet oxon, may contaminate surface waters in the dissolved phase mainly as a result of runoff-producing storm events shortly after field applications.

Appendix A: Summary of Submitted Environmental Fate Studies

1. Degradation Studies

161-1 Hydrolysis (MRID# 40394301)

This study is acceptable and can be used to satisfy the Hydrolysis (161-1) data requirement. No additional data are required. Hydrolysis is considered a major degradation pathway for phosmet at neutral to alkaline pH's.

[^{14}C]phosmet (equally carbonyl-labeled), at 10.43 mg/l hydrolyzed with half-lives of 179 hours, 9.4 hours, and 5.5 minutes in sterile aqueous buffered solutions adjusted to pH5, pH7, pH9, respectively, that were incubated in the dark at 25^{o}C. The major degradates were:

O,O-dimethyl S-phthalimidomethyl phosphorodithioate, which comprised 43.9 percent of applied by day 11 in the pH 5 solution at a concentration of 12.8 micromoles/l.

Phthalamic Acid, which comprised 34.3 percent of applied by day 11 in the pH 5 solution at a concentration of 10.0 micromoles/l.

Other minor degradates, each comprising no more that 9 percent of the applied include:

Phthalic Acid
N-Hydroxymethyl phthalimide
Phthalimide
N-Methylphthalimide

161-2 Aqueous Photolysis (MRID# 42607901)

This study is acceptable and can be used to satisfy the Aqueous Photolysis (161-2) data requirement. No additional data are required. Aqueous photolysis is not considered a major degradation pathway for phosmet.

[1-3-^{14}C]phosmet (equally phthalimido ring-labeled), at 1.5 mg/l, degraded rapidly under aqueous photolysis conditions (Registrant calculated half-life of 2.4 days) in pH 5 buffered solution (unconfirmed), irradiated with artificial light (xenon lamp) on a 12-hour photoperiod. The dark control did not degrade appreciably differently (9.7 days) than the irradiated samples held under similar environmental conditions. Therefore, it is likely, given the rapid aqueous hydrolysis rate at similar pH and the results of the soil photolysis studies (see below), that the mechanism for degradation is likely to be hydrolysis rather than photolysis. The major degradates were:

> O,O-dimethyl S-phthalimidomethyl phosphorodithioate, increased to a maximum of 2.3% at day 3 and was not detected at day 6 or 10. It was not detected in the dark control samples.
>
> Phthalamic Acid, increased to a maximum of 7.8% of applied at day 10 in the irradiated samples and 1.1% in the dark control samples.
>
> Phthalic Acid, increased to a maximum of 6.2% of applied at day 10 in the irradiated samples and 5.7% in the dark controls.
>
> N-Hydroxymethyl phthalimide, increased to a maximum of 5.3% of applied at day 10, however, it was not detected at days 3 day 6. In the dark controls, it was <1.04% of applied at day 10.
>
> Phthalimide, increased to a maximum of 46.7 % at 10 days posttreatment in the irradiated samples and 7.3% in the dark controls.
>
> N-Hydroxymethyl phthalamic acid, increased to a maximum of 20% at day 10 in the irradiated samples and 36.1% in the dark control.

One unidentified non-volatile degradate (D3) was isolated in both the irradiated solutions and dark controls; and four additional degradates (D1, D2, D4, and D5) were isolated only in the irradiated solutions.

161-3 Photolysis on Soil (MRID# 40759801)

This study is acceptable and can be used to satisfy the Photolysis on soil (161-3) data requirement. No additional data are required. Photolysis on soil is not a major route of dissipation.

[1-3-^{14}C]phosmet (equally phthalimido ring-labeled), at 1.87 ug/l, did not degrade on a loam soil irradiated with natural sunlight for up to 30 days at 25^{o}C in Colorado during January and February. Phosmet was 80.8-94.4% of the recovered radioactivity, with no discernable pattern of degradation.

2. Metabolism Studies

162-1 Aerobic Soil Metabolism Study (MRID# 00112304)

This study is acceptable and can be used to satisfy the Aerobic Soil Metabolism data requirement. No additional data are required. Aerobic soil metabolism is a major degradation pathway for phosmet in soils with sufficient microbial activity.

[^{14}C]phosmet (carbonyl- and methylene-labeled), at 5 ppm, degraded with an observed half-life of ~3 days in an aerobic loam soil that was incubated in the dark at ~80 ^{o}F for 308 days. The soil pH was 7.4, moisture 33% by weight (field capacity), with an organic matter content of 5.5 percent. Phosmet was 92.6% of the applied at day 0 posttreatment, 51.3% and 50.3% at 3 days for the methylene- and carbonyl-labeled moieties, respectively, and 1.1% and 1.3% at 150 days for the methylene- and carbonyl-labeled moieties, respectively. The major degradates observed were:

Phthalimide; maximum of 2.4% at 3 days, declining to 0.1% at 60 days posttreatment.
Phthalamic Acid; maximum of 0.5% at 3 days, undetected at 7 days and beyond posttreatment.
Phthalic Acid; maximum of 1.8 at 3 days, undetected at 7 days and beyond posttreatment.
N-Hydroxymethyl phthalamic acid; maximum of 1.7 at 3 days, undetected at 7 days and beyond posttreatment.

These degradates and several unknowns reached a combined maximum level of ~12% of the applied at 7 days, declining to less than 1% at 150 days. Total unknowns did not exceed 6 percent at any sampling interval and declined to less than 1% by day 60 posttreatment.

162-2 Anaerobic Soil Metabolism Study (MRID# 41497801)

This study is acceptable and can be used to satisfy the Anaerobic Soil Metabolism data requirement. No additional data are required. Anaerobic soil metabolism is an important degradation pathway, however, less so than either hydrolysis and aerobic soil metabolism.

[^{14}C]phosmet (carbonyl-labeled), at 4.77 ppm, degraded with an observed half-life of 15 days in an anaerobic loam soil that was incubated in the dark at ~23 ^{o}C for 308 days. The soil pH was 7.1 with an organic matter content of 2.3 percent. Fifteen degradates in addition to CO_2 were identified. Six unknowns were present at less than 0.01 ppm and less than or equal to 6.24% of applied radioactivity. The degradates of phosmet in aerobic and anaerobic soils were qualitatively the same but differed in amounts formed. The major degradates recovered in the anaerobic soil were:

N-Hydroxymethyl phthalamic acid; 14.15% of recoverable radioactivity
Unknown 6; 6.24% of recoverable radioactivity
N-Methoxymethyl phthalimide; 2.95% of recoverable radioactivity
N-Sulfomethyl phthalimide and N-sulfomethyl phthalamic acid; 2.48% of recoverable radioactivity
Phthalamic Acid; 2.27% of recoverable radioactivity
Phthalimide; 1.6% of recoverable radioactivity

The degradate of toxicological concern, phosmet oxon, was 0.3% of recoverable radioactivity after 60 days.

3. Mobility

163-1 Mobility - Adsorption/Desorption (MRID# 40599002)

This study is acceptable and can be used to partially satisfy the Mobility data requirement for parent phosmet. No additional data on mobility of the parent compound are required.

Based on the batch equilibrium experiments, [^{14}C]phosmet was determined to be mobile in a sand soil and moderately mobile in a sandy loam, loam, and silt loam soil. Organic matter content of the soils in the study were between 0.2 and 3.5%. There was somewhat good correlation between adsorption and percent organic carbon; generally, adsorption increased with increase in percent organic carbon. Freundlich K_{ads} and K_{oc} values were as follows:

Soil Type	K_{ads}	K_{oc}
sand	1.17	10400
sandy loam	12.4	975
loam	13.6	757
silt loam	15.8	716

Freundlich K_{des} values were 15.9 for the sand soil, 2.62 for the sandy loam soil, 25.9 for the loan soil, and 27.7 for the silt loam soil.

163-1 Mobility - Leaching of Aged and Unaged Phosmet (MRID# 41142701)

This study is acceptable and can be used to partially satisfy the mobility data requirement. No additional data on the mobility of aged or unaged phosmet are required.

Based on column leaching experiments, aged (six days), phosmet residues were mobile in columns of sandy loam soil. The degradates N-(methanesulfinyl)methyl phthalimide and N-methoxymethyl phthalimide were somewhat mobile; detected only in the soil extracts. The degradate phthalimide was mobile; detected in soil extracts and leachate; the degradate N-hydroxymethyl phthalimide was very mobile; detected only in the leachate.

Based on column leaching experiments, unaged, phosmet residues were mobile in columns of sandy loam (two soils) and loamy sand soils, and slightly mobile in columns of clay loam soil.

4. Dissipation Studies

164-1 Terrestrial Field Dissipation (MRID#41464901; #41464902; #40599003)

This study is acceptable and can be used to partially satisfy the Soil Field Dissipation data requirement. No additional data on the terrestrial field dissipation of phosmet are required.

In this study conducted near Visali, California in the Central Valley, phosmet dissipated with a half-life of 5 days from the top seven-inches of a Foster fine sandy loam soil planted in young pear trees, treated with eight broadcast applications of 5 lbs/acre/application. Phosmet was 0.169-2.78 ppm immediately after the final application. The level decreased to 0.127-0.375 at 3 after final application and 0.084-0.330 ppm by day 7 after final application. The level decreased to less than the level of detection (0.01 ppm) by day 63 after the final application. Phosmet was recovered from the 3.5- to 7-inch depth immediately after the third, sixth, and final application and one day after the final treatment. Phosmet was not detected at any other sampling interval, or below 7 inches at any sampling interval. Three degradates were monitored in the study:

N-Methoxymethylphthalimide, was detected at the 0- to 3.5-inch depth immediately after the third application at 0.072-0.076 ppm. This degradate was not found at any other sampling intervals or depth.

N-(mercaptomethyl) phthalimide S-(O,O-dimethylphosphorothioate) (phosmet oxon) and phthalimide were not detected in any sample at any depth during the study.

In the study conducted in Mississippi near Leland in the major cotton growing area of the delta, phosmet dissipated with a calculated half-life of 8 days from the upper seven-inches of a Bosket fine sandy loam planted in cotton, treated with 10 broadcast application of 1lb/acre/application. Phosmet was 0.518-1.00 ppm immediately after the final application, 0.241-0.392 ppm at day 7 after final application, and 0.055-0.114 ppm at day 14 after final application.

Phosmet declined below the level of detection within two months after final application. Phosmet was recovered from the 0- to 3.5-inch depth immediately after the first, third, seventh, and final applications and at day 3 after the final treatment at the 3.5- to 7-inch and 7- to 10.5-inch depth. Phosmet was not detected at any other sampling interval, or below 3.5 inches at any sampling interval. Three degradates were monitored in the study:

> N-Methoxymethylphthalimide, N-(mercaptomethyl) phthalimide S-(O,O-dimethylphosphorothioate) (phosmet oxon) and phthalimide were not detected in any sample at any depth during the study.

In a study conducted in Orange Cove, California, phosmet dissipated with a calculated half-life of 18.6 days from the upper three-inches of a loam soil (series not identified) planted in mature Modesto ash, treated with three mist blower applications of 3lbs/acre/application. Phosmet concentrations were 0.29 ppm immediately after the third application, 0.21-0.23 ppm at 7-14 days after final application, and 0.08 ppm at 28 days after final application in the 0- to 3-inch sampling depth. Phosmet was recovered from the 3- to 6-inch depth immediately after the final application and was less than 0.05 ppm at all other sampling intervals. Phosmet was not detected below 6-inches. The only degradate identified:

> N-(mercaptomethyl) phthalamide-S-(O,O-dimethyl phosphorothioate) (phosmet oxon) was detected in the 0- to 3-inch depth only at day 14 after final treatment at 0.06 ppm. Phosmet oxon was not detected below 3-inches at any sampling interval. No other degradates were monitored for during the study.

Appendix B: Risk Quotients

A means of integrating the results of exposure and ecotoxicity data is called the quotient method. For this method, risk quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values, both acute and chronic:

RQ = EXPOSURE/TOXICITY

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) **acute high** - potential for acute risk is high, regulatory action may be warranted in addition to restricted use classification (2) **acute restricted use** - the potential for acute risk is high, but this may be mitigated through restricted use classification (3) **acute endangered species** - the potential for acute risk to endangered species is high, regulatory action may be warranted, and (4) **chronic risk** - the potential for chronic risk is high, regulatory action may be warranted. EFED does not perform assessments for chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to mammalian or avian species.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients are derived from the results of required studies. Examples of ecotoxicity values derived from the results of short-term laboratory studies that assess acute effects are: (1) LC50 (fish and birds) (2) LD_{50} (birds and mammals (3) EC_{50} (aquatic plants and aquatic invertebrates) and (4) EC_{25} (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) LOEC (birds, fish, and aquatic invertebrates) (2) NOEC (birds, fish and aquatic invertebrates) and (3) MATC (fish and aquatic invertebrates). For birds and mammals, the NOEC value is used as the ecotoxicity test value in assessing chronic effects. Other values may be used when justified. Generally, the MATC (defined as the geometric mean of the NOEC and LOEC) is used as the ecotoxicity test value in assessing chronic effects to fish and aquatic invertebrates. However, the NOEC is used if the measurement end point is production of offspring or survival.

Risk Presumptions for Non-Target Organisms, with Corresponding RQs and LOCs.

Risk Presumption	RQ	LOC
	Birds	
Acute High Risk	EEC[1]/LC50 or LD50/sqft[2] or LD50/day[3]	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOEC	1
	Wild Mammals	
Acute High Risk	EEC/LC50 or LD50/sqft or LD50/day	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOEC	1
	Aquatic Animals	
Acute High Risk	EEC[3]/LC50 or EC50	0.5
Acute Restricted Use	EEC/LC50 or EC50	0.1
Acute Endangered Species	EEC/LC50 or EC50	0.05
Chronic Risk	EEC/MATC or NOEC	1
	Terrestrial and Semi-Aquatic Plants	
Acute High Risk	EEC[4]/EC25	1
Acute Endangered Species	EEC/EC05 or NOEC	1
	Aquatic Plants	
Acute High Risk	EEC[5]/EC50	1
Acute Endangered Species	EEC/EC05 or NOEC	1

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items

[2] $\frac{mg/ft^2}{LD50 * wt.\ of\ bird}$ [3] $\frac{mg\ of\ toxicant\ consumed/day}{LD50 * wt.\ of\ bird}$

[3] EEC = (ppm or ppb) in water [4] EEC = lbs ai/A [5] EEC = (ppb/ppm) in water